Railway Mechanical Engineer

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The Winner of The Spray Painting Competition Prize

In the November issue we announced a prize competition for the best article dealing with a number of questions with respect to the application, limitations and future of the mechanical application of paint to railway equipment. Although this subject is one in which we know there is considerable interest, few of our readers apparently care to give a public expression of their opinions on it. One good paper was received, however, which is fully worthy to be awarded the first prize. This was submitted by J. W. Gibbons, whose work on the Atchison, Topeka & Santa Fe is well known, and who is thoroughly competent to discuss the possibilities and limitations of mechanical painting. Mr. Gibbons' article will appear in an early issue and we believe will be worthy of the most careful consideration.

Winners in Equipment Design Competition

In response to announcements appearing in the December and January issues of the *Railway Mechanical Engineer,* seven contributions were received in the competition for the best paper on the relation between equipment design and maintenance, telling what can be done to secure improvements in design to facilitate a reduction in the cost of maintenance. Every paper received contains some good suggestions for the designer. Some of these were prepared by designers themselves, while others were prepared by men who view this problem from the maintenance standpoint. It was one of the latter type which was selected as the winner of the first prize because of the number of specific, practical suggestions it contained for improvements in the design of locomotive details which will facilitate or reduce the cost of maintenance. This paper was submitted by Charles Raitt, assistant master mechanic, Atchison, Topeka & Santa Fe, Prescott, Ariz. The paper which won the second prize was presented by H. Y. Carpenter, who views the problem as a designer. Mr. Carpenter is an employee of the Davenport Locomotive Works, Davenport, Iowa. These papers will be published in early issues.

Jigs for Shoes and Wedges

It seems to be the general practice to machine shoes and wedges on a planer. The advantages to be gained by using a milling machine for this sort of work were brought out in an editorial in the February, 1923, *Railway Mechanical Engineer.* However, a large number of shops are not equipped with milling machines suitable for turning out such work in sufficient quantity and, therefore, must use a planer. As a result, numerous devices for holding the work on the platen so as to eliminate the necessity of having to reset in order to finish the various surfaces, are being used in many shops. That there is considerable uniformity in the nature of the devices used should not be surprising to those familiar with the requirements of such work. Practically all of the jigs in use hold the work at the ends so as to permit travel of the tool from one end of a row of shoes or wedges to the other and at the same time permit adjustment for the top or side surfaces as desired. In each case the chief object of the jig has been to eliminate resetting. The idea, however, that jigs and methods can be improved to facilitate the work of setting, as well as to expedite the completion of the job, does not always get the consideration it deserves. From the standpoint of the operator, this feature is really the most important and should be given the most careful study. A jig which requires three-fourths as much time to set up and machine a half dozen shoes or wedges by a complicated method of clamping as it does to perform the same work on as many individual pieces would be more valuable as scrap. Jigs are being used in a number of shops that have effected real savings in labor, and descriptions of a number of these jigs have been published from time to time in the *Railway Mechanical Engineer.* A comparison of the relative merits and possibilities of the devices used in various shops for machining shoes and wedges should eliminate those with outstanding faults and tend to bring about more efficient practice.

How Do You Handle Car Material?

There has been a great increase in the amount of freight equipment acquired by the railroads in recent years and a corresponding increase in the weight and number of parts that must be kept on hand at repair points. Old methods of carrying stock and supplying the needs of the car department have been outgrown at many shops and repair tracks, and there is need for a revision in the methods of supplying, storing and handling material.

With the hundreds of items now used on car repair tracks, for example, it is impracticable for each repair man to look up his own material because of unfamiliarity with its exact location and the length of time necessary for him to find it. Moreover, car men should not be required to do their own trucking. It has been found more advantageous to put in a delivery system of supplying repair materials directly to the cars and thus keeping the repair men at productive work. A specialized delivery force of laborers for the purpose of handling all the materials is an investment which amply repays the time and expense required to develop it.

All material of one kind should be located in one place so that it can be regularly checked, orders placed before replenishing the stock, obsolete material eliminated, and the stock of slow-moving material curtailed. It is essential that no unnecessary stock be carried, as the expense often amounts to 20 per cent or more of the value of the material and railroad capital is tied up in material when it is perhaps badly needed for other purposes.

The use of tractors and trailers for the handling of material has proved very economical. The best results always

follow the close co-operation of the stores and car departments in ordering and handling material as in this way excess stocks are avoided and, on the other hand, a minimum number of delays to equipment are experienced because of lack of material. The delivery force can often advantageously take charge of the removal of scrap material from the repair track, gathering up good material and putting it back into stock, in addition to delivering the new material to the cars.

Treated Lumber in Car Construction

It has been said that the use of treated lumber in car construction will effect larger savings to the railroads than any other feature of car building developed in recent years. Whether or not that statement is fully true, the rapid decay observable in sills, decking and roofing of all-wood and composite freight cars is ample evidence of the need for treatment which will prevent the action of decay in car timber and hence increase the life of the cars. The universal treatment of timber for railroad car and bridge construction was advocated by H. S. Sackett, consulting timber engineer, Chicago, in an article published in the April 26, *Railway Age*, from which the following significant statement is quoted: "The decay of timber and lumber in freight cars represents a yearly loss of approximately $60,000,000 in material, labor and loss of revenue, equivalent to somewhat over 15 per cent of the average yearly gross revenue per car. There are more than $1,500,000 freight cars in service which contain wood where it is subject to decay."

An investigation made by the American Wood Preservers' Association over a period of two years is said to have shown 80 per cent of the repairs to wood and composite freight cars to be caused by the decay of wooden members, the chemical treatment of which would have caused them to outlast their period of mechanical usefulness. Mr. Sackett gave the figure of $50 as the approximate cost per car for lumber treatment and when the resultant increased life of cars is taken into consideration practically any method of figuring will show a handsome profit on this investment.

Another authority on timber treatment submits the following as the life of untreated car timber most subject to decay: "Stock car decking, two to five years, stock car sills, five to eight years, stock car roofing, four to six years, flat car decking, six to eight years, flat car sills, eight to ten years, box car sills, six to ten years, refrigerator sills, four to five years." It will be noticed that the stock car decking is subject to the most rapid decay, lasting only from two to five years, according to this analysis. A prominent mid-west railroad built a number of new stock cars in 1911, using treated sills and decking and it is said that these cars are still in service with the original treated material in good condition. In this case the timber was treated with creosote by the full-cell process and the result was an increase of car life from about five to certainly more than thirteen years.

It is a well established fact that timber treatment by any of the standard recognized processes checks the action of decay and enables a much longer life to be obtained from car material. Not only is the life of car timber itself increased but the premature failure of car members subject to stress in largely prevented. Mechanical failures attributed to faulty design are frequently caused by decay in its early stages which is not easily discernible but which nevertheless reduces the strength of the wood 40 per cent or more. With the increasing price of lumber due to scarcity and the constant urge for reduced net maintenance costs, there is little question that the railroads will go more and more to the use of treated lumber in car construction, particularly for those parts of wooden and composite freight cars subject to rapid decay.

Should Production Be Curtailed?

Doubtless many mechanical officers have wondered whether it really pays to rate a shop on its maximum productive power. It is a fact generally recognized by manufacturing concerns that after production passes a certain point the profits per unit tend to decrease; that is, each plant is limited as to the amount it can produce with the greatest economy. This factor must also be applicable to railroad shops that perform classified repairs and production work for an entire system. Therefore, the mechanical officer in charge of such work is justified in attacking his problem by assuming that maximum production is not always economical production.

On another page of this issue there is an exceedingly interesting article contributed by one of the mechanical department officers of the Buffalo, Rochester & Pittsburgh. One cannot help but be impressed with the fact that the management has seen fit to limit the number of locomotives allowed in the erecting shop at one time. "This allotment," the article states, "has demonstrated its wisdom, as plenty of room is thus provided for working access to the locomotives. In addition to insuring that all material is properly placed, the congestion that naturally follows when a large number of locomotives is in the shop at one time is eliminated."

There are, however, a number of things to be considered before any railroad can decide as to what should be the ideal production for its main shops. The business of railroading differs from that of an industry engaged in manufacturing and marketing what it manufactures. If the shop sold the locomotive, the problem of setting a figure would not be so difficult, but its problem is to keep the locomotive running. This means that the management must know whether the amount of money the locomotive can earn on the road will render sufficient profit to justify the waste in material and wages that is inevitably incurred by crowding the shop. Perhaps some mathematical expert will take the various figures involved and work out a factor of production by which shop output can be determined upon a basis of transportation demands. Such a factor would be a big help in the solution of many railroad problems, but no solution to this problem is possible without close co-operation between the mechanical and operating departments.

Curtailment of production in order to get the most efficient and economical results in shop work is worth careful study by all mechanical officers and men. The operating department can be a big help in arriving at the proper production figure by seeing that the equipment is used to the best advantage. A shop that is not operating at its maximum capacity has something to fall back on when an emergency arises. On the other hand, when a shop is required to operate under congested conditions when traffic is normal, it would pay the management to make an investigation and ascertain if the waste being incurred might not justify an appropriation for buildings and equipment to increase the capacity so that the shop could be run economically.

What Can Be Done

Probably the performance of the Kansas City Southern shops at Pittsburg, Kans., in making a record of seven hours fifty-five minutes for the completion of Class 3 repairs to a heavy Consolidation type locomotive will be regarded with skepticism by many of those who read the account on another page in this issue. It is not the purpose here to enter into any defense of the details of this or of any other similar records which, to some extent, are open to the criticisms that they are "stunts" and that they were made possible by employing impracticable methods. It is enough to call attention to the fact, however, that skepticism is the respect usually paid to all accomplish-

ments which stand out in a marked degree above the average and that it might be well before dismissing the matter as of no practical consequence, to examine carefully into the circumstances to see if there may not be some suggestions for changes in customary practice from which real practical benefits can be derived.

In the account of the Kansas City Southern's record performance will be found three significant facts. In the first place, the officers responsible for the operation of the shops were not satisfied that the full resources of the facilities at their disposal were being utilized, and were not content to continue the old routine without at least a trial of the possibilities of something different. In the second place, the complete utilization of these resources depended on the whole-hearted co-operation of every man in the organization, and apparently that co-operation was fully secured by the interest, shared by officers and men alike, in finding out whether a difficult trial of skill and organization could be accomplished. Every man shared, and has a right to a feeling of personal pride, in the result.

In this particular case, however, the most significant circumstance, and the one most likely to stamp the whole performance as being in the "stunt" class, is the large extent to which the manufacturing departments were eliminated as factors in the progress of the locomotive from stripping to completion. Obviously it would be impossible to complete a Class 3 repair job if the locomotive had to be held while the boiler tubes were cleaned and safe-ended, the tires turned or reset, the driving boxes rebored or refittd and relined, and new bushings applied to the rods. The possibility of such a performance, however, becomes an entirely different matter when the schedule is controlled by the time required to remove from the locomotive one set of parts and replace them with others which have been repaired before the original parts were removed. Including the time required to break in the locomotive, this separation of the floor operations from those of the manufacturing or repair departments means a loss of service time for the locomotive of only two days instead of from thirteen to fifteen days or more were the engine to be held until all of the original parts could be restored.

How far this duplication of parts may be found economical probably will depend on many local conditions, such, for instance, as the number of locomotives of a given class which may be served by a single set of spare parts and how valuable from an operating standpoint the saving in service time of a given class of locomotives may be. The first phase of the problem is one requiring considerable study; the second should be comparatively easy of determination. In most cases the saving of approximately half a month for every Class 3 repair turned out is of such tremendous importance as to justify a careful study of the possibilities of a fairly complete separation of the repairing operations from the erecting operations.

To Whom Does Responsibility Belong?

In a recent address before the Pacific Safety Council on The Management's Responsibility toward Its Employees, Paul Shoup, vice-president of the Southern Pacific, made the following statement: "Never has it been demonstrated to me where the line of cleavage (between management and employees) is and I am not at all sure that I ever want such a demonstration. Indeed, if we can arrive at the point where there is no longer a discussion of who constitutes the management and who constitutes the employees, then and then only will the responsibilities of everyone in the organization become individual with respect to all others engaged in that same enterprise."

Personal responsibility, touched on by Mr. Shoup, is a phase of the personnel question on which not enough stress has been laid. If every railroad man had a clear conception and keen sense of his personal responsibility—to his own ideals; to his fellow-employees, whether superior, equal or subordinate in rank; to the organization he agrees to serve—there probably would be no railroad personnel problem.

The present difficulties in personal relationships are generally attributed to the growth of organizations to their present gigantic proportions, in which the former personal relationships between the employee and the employer have been replaced by contact between thousands of employees acting en masse on the one hand and an impersonal management on the other. Mass action tends definitely to weaken the sense of individual responsibility. An extreme demonstration of this fact is afforded by the action of a mob which in utter irresponsibility may perform deeds revolting even to the most insensible of its members, unless, perchance, a leader of high ideals steps forward to direct its course.

On the other hand, close personal relationships tend to stimulate the sense of personal responsibility and in no small degree it is this fact which inspires the frequent expressions of regret at the loss of the old individual relationships in railroading, heard alike from executives and men in the ranks.

But the size of a large organization does not necessarily preclude the establishment of personal relationships of a kind to awaken effectively the sense of individual responsibility.

The truth of this statement is demonstrated by the army where the effectiveness of the organization is greatly enhanced by the keen sense of personal loyalty usually found to exist between the officers and the men in the ranks. This loyalty is not primarily that of the men for the directing head of the organization, but is a mutual relationship between the men and their company commanders.

The compulsion of military discipline does not and should not exist in the railroad organization, but the same type of personal loyalty with its stimulating effect on the sense of individual responsibility can and should exist in every department of the railroad.

The foreman is the key to this situation. On the quality of his personal leadership depends the effectiveness of the whole organization far more than on the executive and managing officers. Loyalty is a mutual relationship. Few men can inspire it unless they give it in equal degree. The loyalty to the interests of the men whose work he directs is as much an obligation of the foreman as is his loyalty to the company by which he is employed. Any foreman who has not this conception of his job is a misfit.

But the responsibility does not alone rest with the foreman. If there are men in supervisory ranks who lack, or in whom this essential quality of leadership has never been developed, how did they get there? The responsibility for such a condition is to be shared by every officer in the organization, up to and including the president, and it is a personal responsibility which will only be discharged when each one has taken the active interest suitable to his position required to bring about effective training and selection of supervisors for leadership, from the lowest ranks up.

New Books

VIEWS AND REVIEWS OF THE HOT BOX SITUATION. *By J. C. Stewart, general foreman and traveling car inspector, C. I. & W., 50 pages, 4½ in. by 6 in. Price 50 cents. Published by J. C. Stewart, 51 N. Warman Ave., Indianapolis, Ind.*

This book, dedicated to the "better care of journal box and contained and contributing parts," should prove a real inspiration as well as assistance to railroad men in the solution of hot box troubles. The author writes from long experience and the book indicates his broad grasp of the fundamentals of the problem. It plainly shows the desirability of more

uniform methods of journal box maintenance and journal lubrication, due to the interchange of cars from one road to another. The detailed causes and remedies for hot boxes are discussed and particular emphasis laid on the importance of system and perseverance in any attempt to improve conditions.

MECHANICAL WORLD YEAR BOOK, 1924. *Published by Emmott & Co., Ltd., Manchester, England. 348 pages, 3¾ in. by 6 in. Price, 1 shilling 6 pence net.*

The 1924 edition of this handbook contains a number of new sections that tend to increase its usefulness. There is a new and rather lengthy section on fuel combustion. A number of sample problems in flue gas analysis are worked out and also a number of useful tables are given. A section embodying the various rules and formulæ for calculating the strength of flat plates has been added in this edition, as well as a section on tanks. The book is primarily a reference for engineers, draftsmen and practical mechanics and is written for those engaged in work that is being done according to British practice. The various units used are those standard in Great Britain. However, it contains considerable information that is common engineering practice in this country.

PRINCIPLES AND PRACTICES OF UPKEEP PAINTING. *Edited by Roy C. Sheeler. 6 in. by 9 in. 200 pages, illustrated. Bound in fabrikoid. Prepared and published by the E. I. du Pont de Nemours & Co., Philadelphia, Pa. Price $2.*

The text of this book covers in simple, practical fashion modern painting practice for all types of exterior and interior surfaces. It shows both by text and by illustration, the reasons for decay and deterioration of materials and paints and describes the latest and most modern methods to follow in overcoming these difficulties. Each class of building material is handled separately and the methods of surface preparation, paint application, etc., are given in detail. While the entire book forms a practical guide of use to railway men in the handling of plant and equipment maintenance it is likewise of value in regard to new construction. One section of the book of particular interest at the present time is a chapter on mechanical painting in which are included important facts on this method of painting, the care of the equipment and comparative figures on costs.

GENERAL FOREMEN'S ASSOCIATION 1923 PROCEEDINGS. *Compiled and Published by William Hall, Secretary of the Association, Winona, Minn. 210 pages, 6 in. by 9 in., bound with semi-flexible covers.*

This book is a record of the proceedings of the seventeenth annual convention of the International Railway General Foremen's Association held at the Hotel Sherman, Chicago, September 4 to 7 inclusive, 1923. The book is of particular interest because, in spite of a lapse of two years since the last annual convention, the 1923 proceedings proved beyond question that the association is coming back strong and promises to be a constructive force in increasing the efficiency of railroad operation. The Railway General Foremen's Association is one of the strongest of the minor mechanical department associations and has great possibilities for disseminating much needed information regarding railroad shop "men, machinery and methods." A picture of George H. Logan, general foreman, C. & N. W., the present president of the association, is published on page 5, followed by a report of the opening exercises of the convention, the annual report of the secretary-treasurer and the usual committee reports and discussions. The proceedings also contain the highly inspirational address by James C. Davis, director-general of railroads, on the subject "Responsibilities of American Citizenship," an address which will be remembered with pleasure and profit by all those who attended the convention.

What Our Readers Think

Loose Crown Brasses

BINGHAMTON, N. Y.

TO THE EDITOR:

The question raised by Matthew Devlin, in the April issue of the *Railway Mechanical Engineer,* relative to loose crown brasses might be solved by the following procedure:

Make the brass about one thickness of paper, say, .005 in. smaller than the bore of the box, and tip the calipers enough to allow for the pressure required to force the brass in. It will be found that the pressure may be raised considerably while pressing in the brass without the box being sprung out of parallel. This has the effect of drawing the box together and gives a solid fit into the dovetailed annular channels in the box, as the brass has to expand to fit on the sides.

JOHN C. MURDOCH.

How Do You Keep Your Reference File?

CORONATION, Alberta, Canada.

TO THE EDITOR:

I would like to know of a convenient and practical way of filing and indexing various private notes that I want to keep in connection with my work. For instance, I copy articles from your paper and other publications, as well as the company's literature, with the idea of having a compact and handy reference library available when needed. This material has grown to considerable proportions, but is not of much use because the articles I want are not always easy to find.

Any suggestions that you or your readers might have will be appreciated.

J. BOYD,
Locomotive Foreman, Canadian Pacific.

Defective Air Brakes on Freight Cars

LOS ANGELES, Cal.

TO THE EDITOR:

Air brake defects are regulated the same as any other I. C. C. defect but the inspection is not quite so rigid. Most of the trouble on this road is in the retainer pipe and retainers. A great many of the retainer pipes are split, some are entirely rusted off and a large number are broken at the elbow near the end sill. There have also been cases where the pipe has been rusted out on cars equipped with wooden end sills. Of course, these defects cannot be found until the trains are made up and an air test has been made. Such defects have often delayed manifest trains from one hour to 1½ hours. The officers do their utmost to expedite all train movements and sometimes severely criticize the car department for such delays. I believe that if all the cars were tested at interchange points and placed in good condition before proceeding to their destination, there would be very few, if any, delays for the reasons just stated, at central points. A great many foreign cars travel several thousand miles before such conditions are found. If all roads would insist on the air brake equipment being 100 per cent before delivery to the receiving line, the most of this trouble would be eliminated.

I would like to have someone else give their views on this subject.

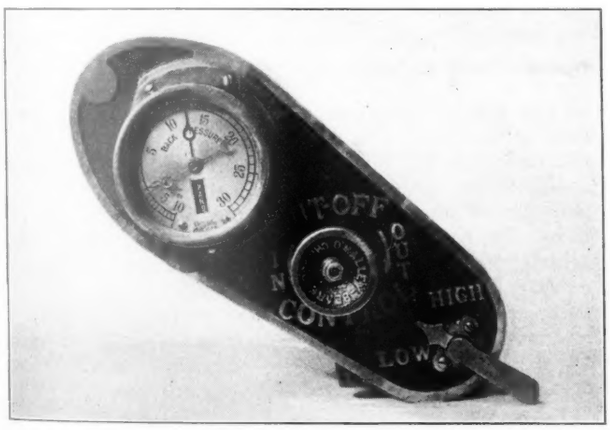
BRYAN BARTON,
Gang Foreman Car Repairs, Southern Pacific.

Nickel Plate Light Mikado, Equipped with Automatic Cut-off Control, Hauling a Dynamometer Car and Test Train

Service Tests of Automatic Cut-Off Control

The Control Device Described—What Its Performance on Two Railroads Has Demonstrated

THE total absence of any means for automatically regulating the point of cut-off in steam locomotives, up to the present time, is contrary to the almost universal use of such regulating devices in the field of the stationary engine. From the days of the first steam locomotive, the operation of the reverse lever has been by the effort and



The Engineman's Back Pressure Gage and Control Panel

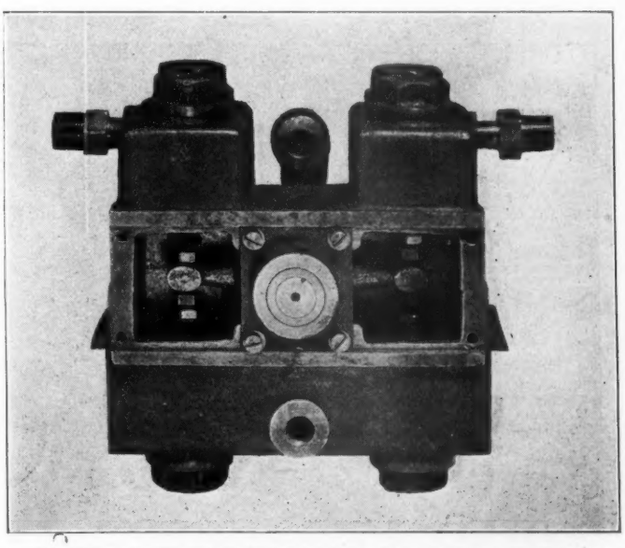
at the direction of the engineman. The development and practical application of a mechanical device, therefore, to perform this operation instead of the engineman, marks the opening of an entirely new field in locomotive development. It is apparent from data already secured that automatic control of the point of cut-off provides the possibility of a marked improvement in locomotive operation.

Device for Automatically Adjusting Cut-off

The mechanical device, tests of which are described in this article, is known as the Automatic Cut-off Control, made by the Transportation Devices Corporation, Indianapolis, Ind. It is actuated by the pressure of the steam in the exhaust passages of the cylinders, and connected to a power reverse gear. The controller, or principal part of the device, is mounted above the power reverse gear and in front of the reverse gear valve. It is contained in a metal box 23 in. by 18 in., by 13 in., located as shown at *A* in the illustration of the locomotive.

The controller is connected to all four exhaust passages of the cylinders by a one-inch pipe. Exhaust pressure is conveyed by this pipe to the pressure regulator unit of the controller and also back to the cab where it terminates in the back pressure gage mounted on a small control panel shown in one of the illustrations. A second pipe connects the controller with the main air reservoir from which the controller obtains its source of power to adjust the reverse gear and hence the cut-off.

Tests made in road service apparently show that, for any given locomotive, dependent on type, size and boiler pressure, there is a definite constant back pressure which, if maintained constant at all speeds above which it is first reached, will permit maximum rated drawbar pull to be developed. This back pressure is held constant by lengthening the cut-off as the speed decreases and shortening the cut-off as the speed increases. Should the boiler pressure change in addi-



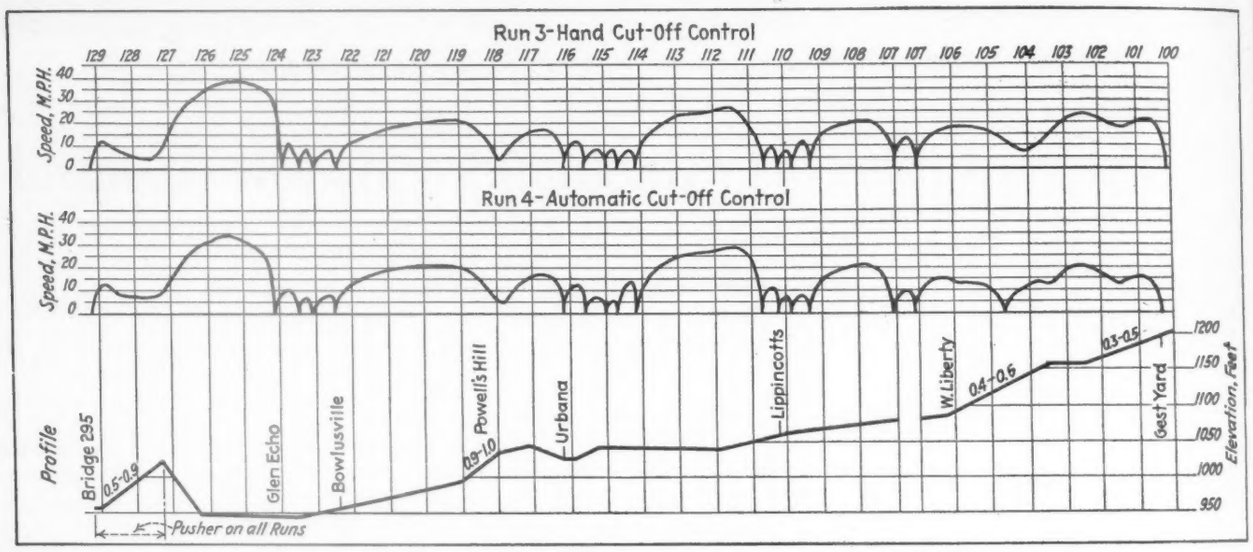
The Reverse Gear Valve Assembly with Poppet Type Valves

tion to a change in speed, the cut-off adjustment will be made accordingly. The proper exhaust pressure to be maintained is shown by the idle hand on the back pressure gage mounted on the control panel in the cab; the actual pressure existing is shown by the movable gage hand.

Once the proper pressure for a particular locomotive is determined, the pressure regulator is so set and this setting is known as "High." A second setting, which may be any-

thing less than the "High" setting, is known as "Low," being determined by the minimum operating requirements. The engineman may change from one setting to the other by means of the handle at the right end of the panel, which is pointing either on "High" or "Low."

Whether the cut-off is to be adjusted by the engineman or by the device depends on the throttle opening. A pipe is run from the right steam pipe back to a primary control valve in the cab. This primary control valve is designed to be set so that with the throttle more than 60 per cent open



Speed Records and Track Profile of Two of the Big Four Fuel Test Runs

the Automatic Cut-off Control makes adjustments of the cut-off.

The air supply from the main air reservoir passes through this valve and the action of steam pipe pressure is to supply or cut off the supply of air to the controller. A small slot in the dial of the back pressure gage displays

Location of the Controller Box (A) and Poppet Type Reverse Gear Valves (C) with Respect to the Reverse Gear (B)

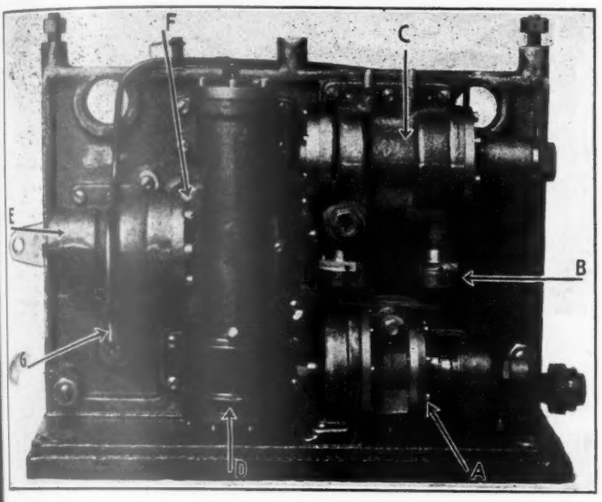
the word "Hand" when the reverse lever is subject to the operation of the engineman and "Auto" when operated by the device.

The engineman can cut the device in or out by the position of the throttle, or permanently cut the device in or out by turning the valve wheel located in the center of the panel. Again the device can be momentarily cut out, even though the throttle is fully open and the panel valve is also open. To do this the engineman holds his foot on the pedal of the foot valve.

In order to hold any predetermined exhaust pressure within the required limits, certain modifications in standard reverse gear design are necessary. The modifications consist of the poppet valve design of the reverse gear valve to eliminate the lap and lead of the slide and rotary valves. Lap and lead must be of independent adjustment and negligible so that fine adjustments and quick response of the reverse gear are positive. The valve of this gear is shown in one of the illustrations. Since the reverse lever must be always available for hand operation and at the same time free to move under automatic operation, the quadrant is circular in form. With hand control the piston of the small locking cylinder at the bottom of the quadrant is against the quadrant, holding it stationary. With the Automatic Cut-off Control in operation the quadrant is free to rotate and allow the lever to follow the gear. The locking cylinder is controlled by the primary control valve, actuated by the throttle opening.

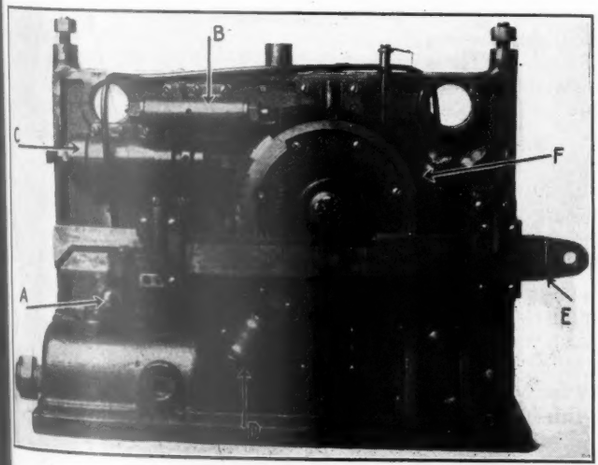
In operation, the locomotive starts the train with the reverse lever in the front corner and the throttle open so that the device cuts in as shown by the word "Auto" on the gage. As the speed increases the back pressure builds up as shown by the gage. If the engine is to be operated at 9 lb. exhaust pressure, when the pressure builds up to 10 lb. the pressure regulator actuates the reduction valve and the controller causes the gear to be hooked up until the pressure is reduced to 9 lb. This will be kept up until the maximum speed is reached and the cut-off is at its shortest, when the controller is prevented from going into back motion. If at any time a grade or other condition should be encountered that would cause the pressure to drop to eight pounds, the cut-off will be lengthened and nine pounds back pressure restored. This may keep up until the reverse lever is again in the corner. The differential of one pound above and below the constant is as close as practical operation will permit, although the controller is said to be capable of one-quarter pound differentials. The exact value of the back pressure maintained has no bearing on the operation of the device which is designed to adjust itself to any pressure to which it is set, the characteristics of the locomotive establishing the "High" setting and minimum operating conditions, the "Low" setting.

Should the engineman at any time close the throttle, the reverse lever will remain where it was before the throttle was closed, and not go to the corner. The engineman, when the device is cut in, cannot move the reverse lever to any other



Front View of the Locomotive Cut-Off Controller with the Cover Removed—(A) Duplex Pressure Regulator, Set to Hold Desired Exhaust Pressure Constant; (B) Reduction Valves Opened by Pressure Regulator, Left Valve Lengthening and Right Valve Shortening Cut-Off; (C) Distributing Valve, which Feeds Air to All Operating Parts on Impulse of Reduction Valves; (D) Operating Cylinder, Which Moves the Mechanical Connections to the Reverse Gear; (E) Cylinder Supply Valve, Feeding Air to and Exhausting Air from the Operating Cylinder; (F) Reversing Head, Governing the Operation of Piston in Operating Cylinder; (G) Primary Adjustment Speed Regulator, Which Governs Rate of Adjusting Long Cut-Offs.

position than that fixed by the controller. He may, however, turn from "High" to "Low" setting, which will immediately change the cut-off to the lower exhaust pressure. To control properly the pulsations of the exhausts at low speeds, a uni-



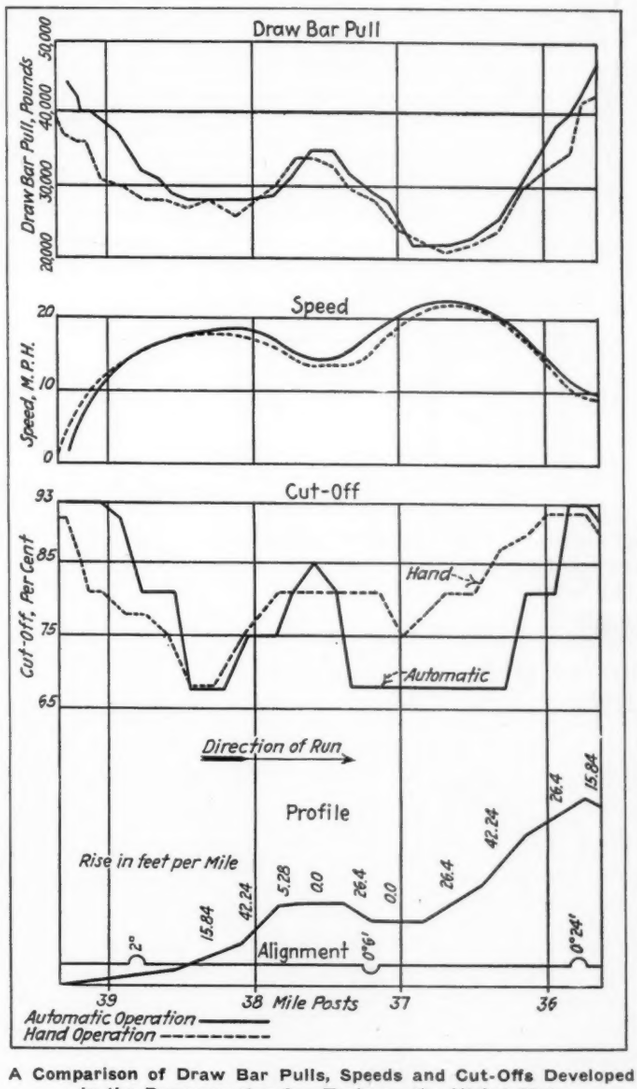
Rear View of the Controller—(A) Secondary Adjustment Speed Regulator, Governing Rate of Adjusting Long Cut-offs; (B) Intercepting Valve, Which Stops Cut-off Adjustment When Longest Cut-off Has Been Reached; (C) Cam Cylinder, Which Determines Whether Operating Cylinder Will Lengthen or Shorten Cut-off; (D) Friction Cylinder Which Maintains Cut-off as Set by the Machine; (E) Operating Rod, Connected to the Reverse Gear Floating Lever by Reach Rod; (F) Ratchet Wheel, Rotated by Opposing Dogs Actuated by Operating Cylinder Piston

flow fitting is inserted in the back pressure line between the cylinders and the controller.

The locomotive engineman has no guide other than a varying degree of experience to assist him in determining the proper cut-off to use. Again because of the many other duties, the attention to which is vital to safety, he is deprived of time, particularly continuity of time, to adjust cut-off. It is the function of the Automatic Cut-off Control to provide accurate and constant adjustments of cut-off and to do this without the attention of the engineman.

Nickel Plate Tests Automatic Cut-off Control

The effect on speed and drawbar pull of cut-off regulation as performed by the engineman and by the Automatic Cut-off Control under competitive test conditions is shown graphically in a chart typical of a series taken from dynamometer car tests of a Nickel Plate light Mikado locomotive, stoker fired, on a three-mile section of test track. Each run required about 15 min. The maximum grade was 42.24 ft. per mile, and



A Comparison of Draw Bar Pulls, Speeds and Cut-Offs Developed in the Dynamometer Car Tests on the Nickel Plate

the maximum track curvature 2 deg. The same train was backed up to the starting point for each test, the engine and crew being the same in each case.

The results of these tests, as borne out by the charts, may be summarized as follows:

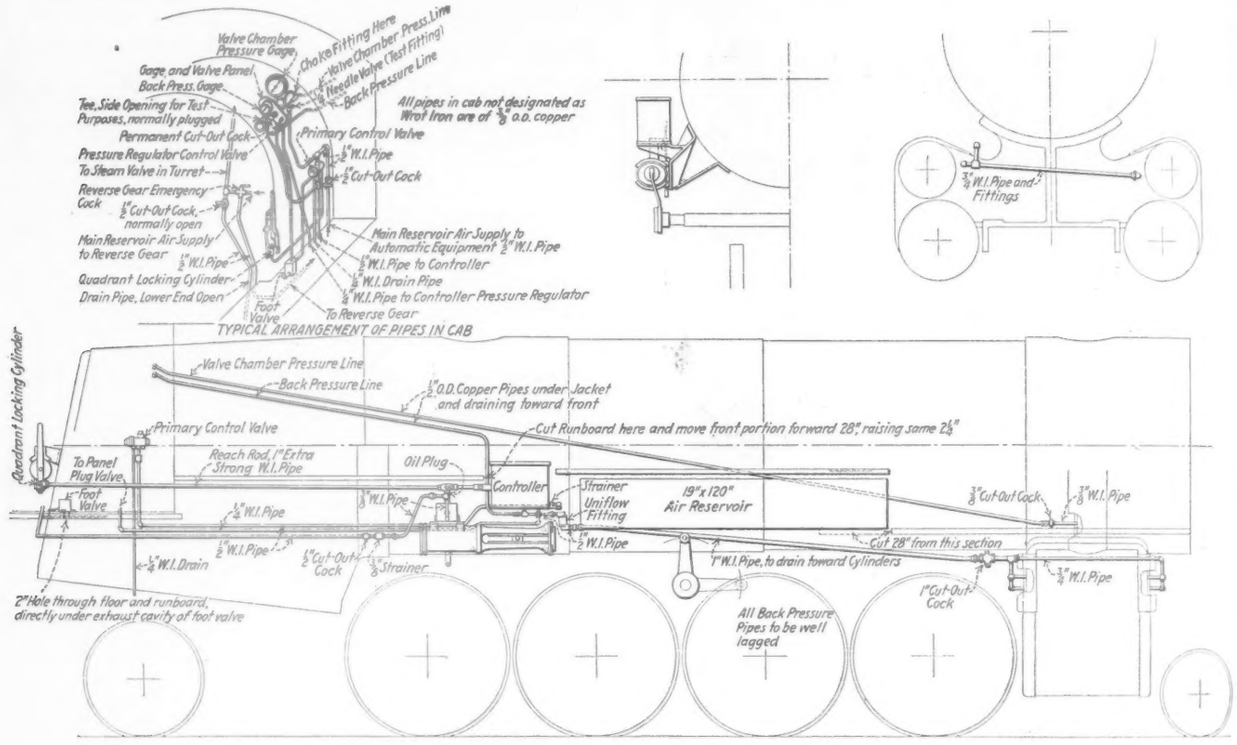
1—There was no appreciable difference in the minimum speeds of the respective trains over the grade where minimum speeds would naturally be expected.

2—There was a decided difference in the cut-offs used by the enginemen and by the Cut-off Control. In starting the

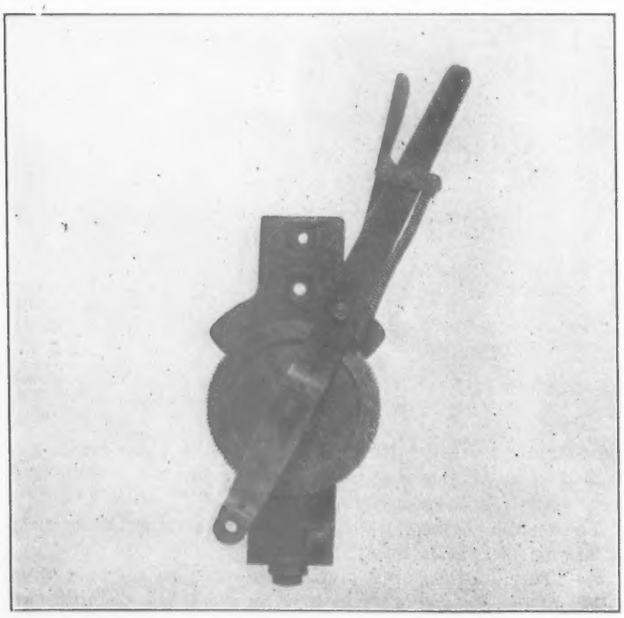
train, the reverse lever remained in the corner longer with the Cut-off Control than when operated by the enginemen, but this was an advantage in getting more quickly to the higher speeds and shorter cut-offs. In slowing down, the Cut-off Control did not hook down the reverse lever as quickly as the enginemen did. In running, shorter cut-offs were used and for greater periods of time when the Cut-off Control was in operation.

3—The Cut-off Control generally showed equal or better speeds, drawbar pull and drawbar horsepower than those obtained by the enginemen, regardless of the longer cut-offs used by the latter.

4—The time performance between mile posts was generally in favor of the Cut-off Control.


Valve Chamber Pressure Gage
Choke Fitting Here
Valve Chamber Press. Line
Needle Valve (Test Fitting)
Back Pressure Line
Gage and Valve Panel
Back Press. Gage
Tee, Side Opening for Test Purposes, normally plugged
Permanent Cut-Out Cock
Pressure Regulator Control Valve
To Steam Valve in Turret
Reverse Gear Emergency Cock
¾" Cut-Out Cock, normally open
Main Reservoir Air Supply to Reverse Gear
1" W.I. Pipe
Quadrant Locking Cylinder
Drain Pipe, Lower End Open
Foot Valve
All pipes in cab not designated as W'rot Iron are of ⅜" O.D. copper
Primary Control Valve
½" W.I. Pipe
2" Cut-Out Cock
Main Reservoir Air Supply to Automatic Equipment ½" W.I. Pipe
½" W.I. Pipe to Controller
½" W.I. Drain Pipe
¾" W.I. Pipe to Controller Pressure Regulator
To Reverse Gear
TYPICAL ARRANGEMENT OF PIPES IN CAB
⅜" W.I. Pipe and Fittings
Quadrant Locking Cylinder
Valve Chamber Pressure Line
Back Pressure Line
1" O.D. Copper Pipes under Jacket and draining foward front
Primary Control Valve
Cut Runboard here and move front portion forward 28", raising same 2½"
To Panel Plug Valve
Foot Valve
Reach Rod, 1" Extra Strong W.I. Pipe
Oil Plug
Controller
Strainer
Uniflow Fitting
19"x120" Air Reservoir
⅜" Cut-Out Cock
⅜" W.I. Pipe
½" W.I. Pipe
¾" W.I. Pipe
½" W.I. Drain
2" Cut-Out Cock
¾" Strainer
Cut 28" from this section
1" W.I. Pipe, to drain foward Cylinders
1" Cut-Out Cock
2" Hole through floor and runboard, directly under exhaust cavity of foot valve
All Back Pressure Pipes to be well lagged

General Piping Diagram of the Automatic Cut-off Control



The Reverse Lever Assembly Includes a Circular Quadrant Which is Held Stationary with Respect to the Bracket, for Hand Operation, by the Locking Cylinder at the Bottom of the Bracket

5—The enginemen as a rule anticipated the grades by lengthening the cut-off in advance of the train actually being on the grade. The Cut-off Control did not lengthen the cut-off until the grade resistance had actually made itself felt upon the train, this being particularly noticeable between mile posts 38 and 37. It is evident that if shorter cut-offs can be used without lessening the drawbar pull or speed for short runs, the cumulative effect over the entire division will be conducive to lower fuel consumption and better time and tonnage performance.

Because of the shortness of the Nickel Plate tests it should be noted that the enginemen were in a position to devote all the time necessary to adjusting the reverse lever and to take advantage of their knowledge of the road-bed gained through years of experience. They could also look ahead and on approaching a grade take advantage of any peculiarity which might make the lengthening of the cut-off advisable had such a thing been the proper thing to do. The fact is that the enginemen really lengthened the cut-off at the wrong time because of their mental attitude as to the necessity for it.

Fuel Economy Tests on the Big Four

In order to determine the effect of the Automatic Cut-off Control on fuel consumption this equipment was applied to a C. C. C. & St. L. Mikado locomotive, No. 160, and a series of tests run between Springfield, Ohio, and Bellefontaine, Ohio. Tests made on the same class of locomotive over the same territory, in April, 1923, had indicated that 13 lb. back pressure was the proper setting for the automatic cut-off governor, and this setting was used during the fuel tests.

A total of four runs were made in the eastward direction between Springfield and Bellefontaine, two runs with the cut-off controlled by the engineer and two runs with the cut-off controlled automatically. The same train was used during

each test, but due to heavy rains during the second, third and fourth tests the train, which consisted entirely of loaded coal cars, gained in weight. An allowance of four per cent of the total weight of lading was added to the original weight to offset this factor.

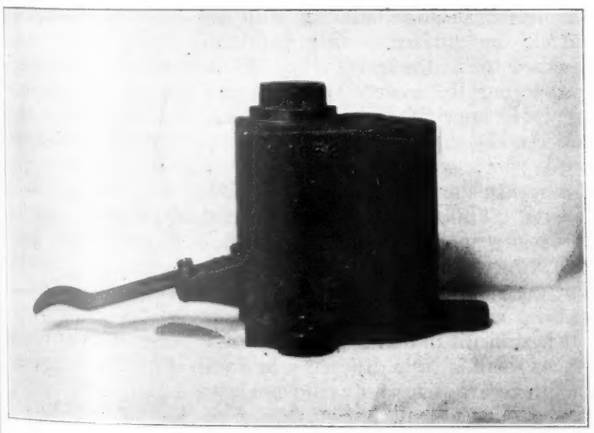
The coal burned during the tests was loaded from one car, held for this purpose at Springfield, thereby keeping the grade of coal burned constant. Coal was weighed onto the tank previous to each run, and the coal left at the end of each run was weighed off. In addition, the weight of the coal fired before and after each test was taken. The coal figures for the test runs, therefore, include only coal actually burned from the start to the finish of the runs.

In order to make the four runs truly comparable, it was necessary to keep the number and location of stops and starts constant. For this reason, every siding was entered, and the moves in and out of each siding were the same on each run. The speed records, two of which, together with the track profile, are included, show how closely the moves of the test runs compare.

TABLE I—GENERAL DATA AND RESULTS OF BIG FOUR FUEL TEST RUNS

	Run 1 Hand	Run 2 Auto	Run 3 Hand	Run 4 Auto
Actual train tonnage	3,597	3,701†	3,714†	3,714†
Adjusted train tonnage	4,347	4,451	4,464	4,464
Running time, min., bridge 295 to Gest yard	158	176	171	169
Standing time, min.	139	158	186	228
Total time on road	297	334	357	397
Average running speed, m.p.h.	11.2	10.1	10.4	10.5
Average max. speed between stops, m.p.h.	16.3	14.1	14.3	14.1
Min. speed over ruling grade, m.p.h.	9.5	4.0	3.5	5.0
Average steam pressure, lb. per sq. in.	191	195	192	194
Coal fired, lb.	14,713	13,709	15,631	12,960
Water evaporated, lb. (10 per cent return by heater)	91,135	92,730	95,480	96,525
Lb. water evaporated per lb. coal fired	6.19	6.76	6.10	7.45
Lb. coal fired per 1,000 gross ton miles	138.8	125.4	142.7	118.1 128.9*

†Includes 103.8 tons, estimated increase in train weight due to rain during test runs 2, 3 and 4.
*Based on mileage to point of stall at mile 104.7.



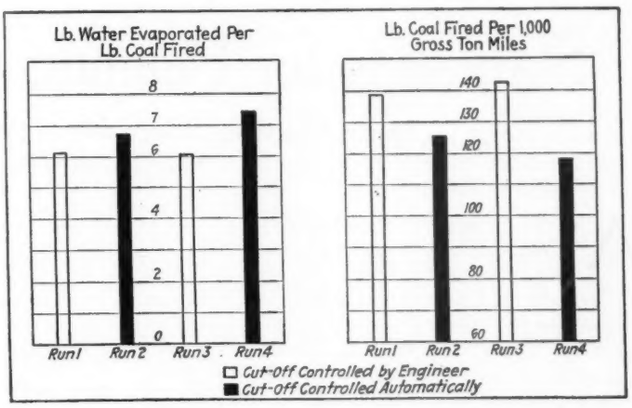
Foot Valve for Temporarily Cutting Out the Automatic Cut-Off Control

The tank of the locomotive was calibrated and water readings taken at each stop. The feed water heater was credited with a 10 per cent return to the tank during each run. The booster engine was cut in at all starts, but was not used on the ruling-grade, Powell's Hill, during runs 1, 2 and 4. On run 3, with hand operation of the cut-off, it was necessary to cut in the booster near the top of the hill.

The standing time in sidings was kept as constant as possible. The time standing was greater on runs 2 and 4, with the cut-off controlled automatically. This, without doubt, caused a slight increase in coal consumption but no effort was made to estimate the amount. Runs 1 and 2 were made with different engineers, while runs 3 and 4 were made with the same engineer.

The stall which occurred between West Liberty and Gest Yard on run 4 was due to a shower which caused bad rail conditions, and inability to get sand to the rail resulted in the engine slipping. A train following pushed the test train about 30 car lengths after which Engine 160 handled the train alone. The coal consumption per ton mile, for this reason, was calculated up to the stalling point and also including the stall.

The general averages developed by the test runs are given in Table I. From the standpoint of fuel economy, the two automatic cut-off runs show an increased water evaporation rate and a decrease in coal consumption per ton mile as compared with the two runs where the cut-off was controlled by the engineer. The results indicate that with this class of locomotive a gain of approximately 10 per cent in water evaporated per pound of coal fired and an approximate decrease of 10 per cent in coal consumed, may be expected by automatically controlling the cut-off.



Graphical Comparison of Big Four Fuel Test Results

It should be noted that the actual running time on all tests, with the exception of the first where the lading was dry and the train lighter, is nearly the same. The more effective firing under the constant draft conditions held by the automatic cut-off combined with more uniform accelerations from stops, account for the increased rate of evaporation and reduced coal consumption, indicated graphically in one of the charts.

Operating Results in Slow Freight Service

The effect of better average drawbar pull and speed on economic operation is shown by the following operating data taken from competitive cut-off control tests in slow freight service on the Cincinnati Northern, a subsidiary of the Big Four:

	All engines same class	Engine with automatic cut-off	Per cent, increased production
Average miles per hour, total time	10.1	11.3	....
Average gross ton miles per hour, 1,000	32.61	39.2	20.2
Average gross tons per train	3,239	3,477	....

This shows the accumulated effect on the rate of production, in terms of 1,000 gross ton miles per hour, of regulation of cut-off to develop maximum rated drawbar pull at each speed.

It is interesting to note that increased tonnages do not reduce the speed as much as might be expected when the cut-

off is adjusted automatically. This is clearly brought out by the following comparison, over the same territory and service:

Actual train tonnage	Speed, running time, m.p.h.
3,300–3,400	15.2
3,400–3,500	14.6
3,500–3,600	14.8
3,600–3,700	14.4

Certain mechanical and operating advantages, claimed for the automatic control of cut-off and substantiated in varying degree by the tests, are as follows:

1—Standardization of exhaust nozzle sizes. This is possible because the locomotives are uniformly operated as to cut-off.

2—Elimination of water stops. The proper use of cut-off saves water and eliminates certain stops that are now occasionally made, requiring the maintenance of water supply stations that may otherwise be eliminated.

3—Uniform conditions of firing. Constant back pressure provides constant draft and firemen do not have to carry excessive fires in anticipation of a heavy pull on the fire because of the sudden use of long cut-offs.

4—Shock on reciprocating parts is lessened. As the pistons are opposed by a constant exhaust pressure, they are not subject to shocks where this pressure varies widely.

5—Lubrication protection in drifting. The back pressure gage is calibrated to register a vacuum; if in drifting the throttle is shut off only to the extent that no vacuum is created in the exhaust passages, no smoke box gases will be drawn into the cylinders to destroy lubrication.

6—Elimination of valve setting errors as they effect cut-off. It is difficult and practically never possible to set the valves so that the same quadrant notch on all engines of the same class will give the same per cent of cut-off. As the Automatic Cut-off Control adjusts the cut-off independent of any mechanical condition as to reach rod length, the proper cut-off is used regardless of errors of this nature.

7—Safety of operation. Many times on critical pulls the engineman is required to watch for signals, the brakes, the sand, the injector and the throttle to keep from slipping. A moment lost in handling the throttle and sand may cause slipping and stalling of the train.

Standards for Painting Cars and Locomotives*

Many Practices Which Have Been Successful Are Reported to Equipment Painting Division

As the committee was handicapped by circumstances which prevented meetings being held during the past two years it was, therefore, deemed advisable to submit reports as drawn up by individual members of the committee covering the various subjects and questions placed in their hands for consideration. Definite recommendations as a committee were withheld for the reasons stated. The subjects considered were twenty-four in number, part of which follow:

Subject No. 5—Finishing Interior of Steel Passenger Cars

B. E. Miller: The best method consists in providing a smooth surface in the usual manner and then graining it in imitation of natural wood. From the standpoint of appearance, mahogany is perhaps preferable, particularly if the surface, after having been grained, has had two coats of rubbing varnish and has been rubbed down to a smooth, dull finish with pulverized pumice stone and water or oil.

This method is expensive but it has its good points. For instance, a dull, rubbed finish does not show up finger marks or other blemishes nearly as conspicuously as one which has been allowed to go in gloss, in which case all varnish imperfections and particles of grit are bound to show up. Not only is the dull, rubbed finish pleasing to the beholder, but it is easily taken care of. The grained surface, because of its mottled effect and unevenness as to depth of colors, is also of help in obscuring blemishes incident to wear and use.

The maintenance of a grained surface is expensive because many portions of a car interior are subjected to severe usage. By friction and abrasions, varnish and graining color are removed in spots, exposing the ground color in a conspicuous manner. Spots of this kind cannot be touched up or hidden successfully. Frequently large panels have to be refinished in order to hide a comparatively small imperfection. This, perhaps, is as great a drawback to the system of graining car interiors as any and has caused many roads to adopt a cheaper practice by painting with opaque or solid colors.

A second method, though probably inferior to the grained surface, consists in surfacing up and painting in single or parti-colors, then varnishing and rubbing to a dull finish. Durability will be equal to method No. 1, though there are few who would not prefer to have the surface painted and grained. We have been used to natural wood on the interiors of cars for so many years, that for a while, at least, the public will cling to it until general usage has brought about a change of tastes.

A third and still cheaper method, though practical and durable, consists in painting with two coats of a durable enamel, the surface having previously been painted and smoothed up in the usual way. If the craftsman is careful in applying the material and avoids dirt or grit, a very acceptable appearance is provided. A dull appearance can be secured by rubbing with pulverized pumice stone and water or oil, which will also get rid of any gritty appearance or other conspicuous imperfections. It is very seldom done, however. This method is the cheapest of the three and for ordinary steel passenger car interiors is considered good enough by a number of roads. It is also to be preferred from the standpoint of maintenance, it being the easiest to touch up and keep in presentable shape.

It is difficult to decide which of these three methods is the best, as there is little difference in durability. As to appearance, there are few who would not have a preference for the grained surface and accept the other two methods in the order named. It then remains a question as to how far a road is willing to go to make its equipment attractive as to appearance.

Subject No. 7—Treatment for Steel Underframes

D. A. Little: The only effective thing is the sand blast, but as this is almost impractical owing to the fact that neither time nor opportunity is allowed, wire brushes are the next best thing to use. However, even this is not generally practiced for the same reasons. As a primer I would say that graphite or a good mineral paint similar to standard weight car paint is about the best and cheapest to use for this purpose, providing time and opportunity is allowed—otherwise, no, as it is only a waste of material and labor to paint over dirt and grease. I would say the same in regard to coal spaces and tops of tenders undergoing repairs. Of course,

*Abstract of the committee report submitted at the meeting of the American Railway Association, Equipment Painting Division, held at Chicago, September 4, 5 and 6.

the new tender frames and coal spaces are always painted.

W. H. Truman: The best method for removing scale and rust from steel underframes, where sand blast is not available, is to use a hammer made for the purpose with both ends sharp to crack the scale, then scrape with a scraper made from a file, then thoroughly rake with a wire brush.

The best primer for this class of work, after the surface has been thoroughly cleaned, is to apply one coat of princess metalic, mixed with ⅔ linseed oil and ⅓ spirits turpentine where time will permit, then finish up with one coat of lamp black ground in linseed oil or a good substitute oil.

Subject No. 8—Care of Ventilators and Deck Sash

C. A. Cook: It is becoming more and more evident that constant care is essential in connection with these parts of our steel passenger equipment if they are to be preserved from corrosion and decay even for a minimum period of service.

We know full well the importance of the initial treatment of these parts if the maximum life and service of the steel is to be secured. Assuming that the utmost care has been given the steel both in its preparation and protection, we can feel that it has been given a fair trial in its initial treatment.

The danger lies in allowing corrosion or rust to get a start. This can be avoided only by vigilant inspection. If rust is found at any point it should be removed thoroughly and the parts repainted. It is a safe course to confine inspection of these parts to the periodical shopping of the cars, but that at terminal points frequent inspection should be given.

The summary is, that the proper care of the ventilators and screens of steel passenger cars, lies in frequent and careful inspection, prompt removal of all rust or corrosion, and immediate protection by painting.

Subject No. 10—Prolonging the Life of End Structures of Express, Baggage and Mail Cars Constructed of Wood by Sanding

J. H. Kahler: The practice of sanding the ends of this class of equipment is a good means to prevent cinders cutting away the painted surface and exposing the wood to the elements. It is my opinion that a thick coating withstands cinders longer than a thin coating; also that if a material of a rubber-like nature were applied it would stand the wear of the cinders much better than the present practice of applying mineral paint and sanding. The sand of course retards the cinder cutting, but when the sand is cut away, the paint underneath perishes more rapidly, so that if this paint coating were of a rubber-like nature and if enough of it were applied, it would be an improvement over sanding, as the cinders would bound off without cutting off of the coating to any great extent. At least it would make a surface that could be cleansed whereas the sanded surface is hard to clean and it is difficult to remove the grease thrown up from the wheels.

Subject No. 18—Treating Tenders for Painting, Where They Have Been Cleaned with Washing Fluid

J. H. Kahler: To do this we use the material to suit conditions. If strong soap does not remove it we use weak lye and scrub into this with a palmetto fiber scrub brush, placed on a handle. Where conditions demand in different spots, we use also benzine and kerosene mixed, along with the use of a wire scratch brush. We try to keep ahead of the lye by the use of water in rinsing off frequently while cleansing; after it is dry a thorough scouring with emery cloth makes it ready to receive the painting.

Subject No. 21—Maintenance—Paint and Varnish on Locomotives

J. H. Kahler: I think it good practice to have one or more painters stationed at the enginehouse to repaint minor parts of the engine when held for repairs. Occasionally an engine is in long enough to give it a thorough cleaning and recoloring that makes it look "just out of shop." The cleaning of the engine proper should be done with an oil cleaner after grease and oil have been removed with kerosene and the oil cleaner must be thoroughly removed. The cistern is a different proposition owing to more or less sweating being present. Here I think it a good plan to wash off with weak soap and water and kerosene oil to remove all greasiness and grit and follow up with a varnish renovator.

The greater part of this kind of work should be done during the summer months as the winter months are not so favorable. Where there is no striping on engines this practice results in better appearance and protective qualities, but where striping is done on drivers, cab or tender, it is not possible to do this in so short a time and the result is the engine goes into service with a cleaned and touch up job, instead of a complete recolored appearance. This work can be done with varnish added to engine finish until the engine gets general repairs again.

Subject No. 23—Varnishing Locomotives by the Spray System

D. A. Little: I am opposed to the use of the spraying machine in varnishing surfaced work as the material will not flow out as nicely as when applied with the brush.

It is quite practical, however, to spray tender trucks, pony trucks and main engine frame provided you do not get into trouble with machinists who are working on the engines. They will not tolerate its use and from a hygienic standpoint I consider spraying paint wrong.

J. H. Kahler: I have never been in favor of applying varnish with the spray machine; being one of the first to use the spraying method and having tried the spraying of engine black to tenders, I draw the line at varnishing. We all know the most important operation in applying varnish is to get a perfectly even distribution, so that flowing will be exactly the same at every part of the surface. Then comes the careful wiping and slicking up to avoid sags and runs to insure a perfect surface. Can the spray machine accomplish all this? I have my doubts, when taking into consideration the difference between a clear liquid varnish and a mixed paint composed of oil and pigment which holds the oil in suspension, while the varnish has no pigment to rely on. I should want to follow up the spray machine with a brush if I were to spray varnish on a cistern covered with rivets in order to avoid runs or sags.

Subject No. 24—Painting a Locomotive and Parts Practical to Paint with Spraying Machine

J. H. Kahler: What the best methods are for painting engines is hard to determine, as the same rule could not be applied to all shops owing to climatic conditions, shop practice and shop conditions. I can only say how I would do the work with economy, at the same time considering durability and appearance.

We all know that a clean engine looks far better than one not cleaned. The main object is to paint them so that the cleaning may be done without much effort or expense; to bring this about the surfaces should be filled up smoothly and protected with enough varnish to make for durability. For economy's sake, all striping may be omitted. When we consider the hard life of an engine, out in all kinds of weather and the amount of dirt accumulation it picks up, it seems to me that durability should be the main factor, and the appearance would depend on the amount of cleaning done.

A durable smooth surface depends largely on the foundation, which in turn depends entirely on the priming coat which should be carefully prepared. In building up the surface care must be taken in handling the putty and glazing

coats in such a manner as to eliminate to a great degree the necessary cutting down to a smooth surface. On this surface one coat of flat color is to be applied and followed with one coat of varnish color. Lettering is to be placed on this coat and the surface given two coats of finishing varnish.

The spray machine can be used to great advantage and a saving in time and labor on such parts of locomotive as frames and spring rigging, brake rigging, engine trucks, tender trucks and frames and when boilers are to be painted before lagging is applied.

The Qualities of a Successful Foreman

Standing Between His Management and His Men, His Great Responsibility Is That of Leadership

By R. E. May
Car Foreman, Chicago & Eastern Illinois, Danville, Ill.

SUCCESS is not measured by the position one attains or the salary he gets, but by how well he is doing his job. Is he putting 100 per cent effort into the work? Is he using all the talents and knowledge he possesses in carrying it out?

A foreman to be successful should be of the highest type morally. He is the personal contact between the men he supervises and the company for which he works. The men form their opinions of that company largely from the type of man the foreman is. The public which is an important factor to be considered, also forms its opinion from its association with the local officers. The supervisors should, therefore, be in a position to command respect and confidence.

The foreman should have confidence in the company for which he works if he is to be in a position to inspire that confidence in others. If there is any one thing that needs developing and stimulating on the railroads, it is confidence. We have needed it in the past eighteen months in the training of new men and in developing in them a broader conception of railroading than a mere source of wages.

Next, the foreman should be considerate. He should have consideration for the company he represents, consideration for the public the company serves, consideration for the men he supervises, consideration for the other branches of the work in which he is not directly interested.

He should also possess knowledge, not only of his particular job, but of every phase of the business in which his company is engaged. This will give him a broader view and he will be better able to understand and serve his company. Of course, he should specialize on his particular job. He should have some definite plan in mind. In other words, he should always know what he wants to do, but he should not be afraid to ask questions and find out why things are done a certain way and why they cannot be done a better way. Big things are seldom accomplished by one mind. If he has an idea that is good, or that he thinks is good, then he should submit it to the test of criticism. If it stands the test, then the chances are that it is practicable. Knowledge is obtained in three ways, by reading the experience of others along similar lines, by getting the actual experience and by asking questions.

The bigger you measure up to your work, the easier you will find it and the swifter will be your progress in it. Foremen often become discouraged because they do not advance faster. They think they are being held back while someone else gets the coveted place. It is often said that the other fellow has a pull or is lucky. But in nine times out of ten it is preparation and knowledge that has put him ahead. The man who expects to win success without self-denial and self-improvements stands about as much chance as would a prize fighter in the ring without first having trained for the bout.

The foreman should have a spirit of co-operation. Working with others means not being afraid that you are doing too much and the other fellow is doing too little. A first-class man gives all there is in him because he knows that the most he can give is little enough. He never bothers about the possibility of contributing more than his share.

What the railroads are looking for and what they need is men who cannot become satisfied with themselves; men who consider what they have done as a fraction of what they could have done. Only a man of this type can truly co-operate and in order to get things done, there must be co-operation.

Most men are afraid of responsibility; they are willing to venture an opinion, but when it comes to deciding on definite action they like someone else to take the final step. It takes a lot of work and study to fit one to discharge a responsibility with accurate and positive judgment. When one assumes responsibility for a thing, however, he becomes interested, and he begins to get things done.

One of the greatest responsibilities of a foreman is that of assuming a personal leadership over his men in all matters affecting their attitude toward the company. In order to do this he must have a good knowledge of human nature. A foreman's task is to make every worker in his unit as efficient as possible. The achievement of this task makes it necessary to consider every one of his workers from the three points of view of capacities, interests and opportunities.

Capacities are those attainments of mind and body which a worker is able to bring to his work and which, if he chooses, he can exercise in its performance. It has been said that each one of us is a symposium of what he was born with plus what he has acquired through personal experience. Experience in this sense includes education and training. If it were possible to tabulate a list of man's capacities, it would probably include such characteristics as physical health, physical strength, eyesight, hearing, temperament, appearance, judgment, initiative, aggressiveness, thoroughness, disposition, education and general or specific knowledge.

Interests are the springs of action which make capacities work. When interest is co-ordinated with capacity, then the individual must of necessity become an efficient worker if he is given the opportunity.

This brings us to the third point. Opportunity does not necessarily mean opportunity for advancement, but opportunity to make use of the abilities with which he is endowed by inheritance, environment or experience. Now if we have a worker in a position where he has no opportunity to exercise his ability, then it is wasted so far as its benefit to the company is concerned.

It would be hard to find a man who is perfectly balanced with respect to these three fundamentals. If one had capacities suited to a certain kind of work and the opportunity

to exercise them, but lacked interest in that particular work, there is no need for me to tell you that he would not be efficient. You might compare him with a locomotive with its boiler, firebox, cylinders and pistons as capacities, which it can put to work to develop power, provided the fire and steam pressure are there also. Men are equipped with brains, eyes, arms, legs and health, capacities they can put to work provided they are quickened by the fire and steam of interest. I cannot emphasize interest too strongly because without it our capacities and opportunities avail us nothing.

It is a common failing with most of us to attribute to others the desires which actuate ourselves. If we go to the theater and see a good play, we tell others about it and want them to see it. The foreman must first himself be interested to arouse interest among the men he supervises. Men who have the interest, and opportunity, but lack the capacities, within a short time make more efficient workers than men who have capacities and opportunities, but whose interests were out of adjustment.

If a foreman has a man who has both capacities and interests, then he should provide him with an opportunity to exercise them to the fullest. If the man has capacities for some other branch of the work over which the foreman does not have jurisdiction, then he should confer with his superior in trying to place this man where he will be interested, contented and most useful to the company.

Possibly exceptions will be taken to these methods and it will be said that if a man doesn't want to work then he should be discharged. That was the old order of things, when the foreman discharged one or two men to put fear into the others. Men cannot work to the best advantage to themselves and the company through fear. Men must be led to believe that they are an important part of industry, the success of which depends on how well they do their work. Men should also be taught by the foreman that the company esteems them for more than what they produce.

A foreman should never make promises to his men that he cannot fulfill. He should be fair and just and when he is asked a question, no matter how simple it may sound to him, he should endeavor to answer it to the complete satisfaction and understanding of the one who asked it.

It makes no difference how much the management believes in a square deal for its employees or how much it believes in providing opportunity for advancement or in building men up to higher ideals and a broader conception of their responsibilities and service, if the foreman who has the direct supervision is not actuated by the same high standards, those of the management will avail nothing. The company, the same as the employees, will be the loser.

I do not mean to infer that a foreman should accede to every demand. But he should be in a position to defend and explain whatever action be taken. A foreman should defend the principles of the company and endeavor by word and action to endow others with the same attitude.

A foreman should be familiar with costs. He should know approximately the cost of a siding board, a flooring board, or any other material that is likely to be damaged by push cars or wheels when lying on the track or where other material is thrown on top of it and it is damaged so that it is not fit for further use. Bringing too much or the wrong kind of material out to a car, then leaving it to be thrown around until it is not fit to use should be avoided. If each employee knew that a certain item of material represents a certain sum of money and was impressed with that idea by his foreman, there is no doubt but that within a short time he, too, would manifest a like interest and within a year's time it would be hard to estimate the saving that would be accomplished. It is the mutual interests of employer and employee that brings about harmony and success. Too often we become used to seeing things done a certain way in the handling of material that we do not stop to realize the amount of money spent to replace it. If we were made the proposition of buying the material we use from the store department and paying for it in cash with the responsibility of having to make up any money that was mis-spent or spent for material not needed, I am sure we would practice more economy.

A Heavy Six-Wheel Switch Engine

AN order of six-wheel switching locomotives has recently been delivered to the Union Railroad by the Lima Locomotive Works, Inc., which are heavier and more powerful than most locomotives of this type. The locomotives have a total weight of 182,000 lb., averaging about 60,700 lb. at the rail per pair of drivers, and develop a maximum tractive force of 42,900 lb.

In mechanical details the design is straightforward and rugged. Both as to cylinder power and boiler capacity, however, the locomotive is unusually large for this type. The cylinders are 22 in. in diameter by 28 in. stroke. The boiler, which has a total evaporative heating surface of 2,191 sq. ft. and 506 sq. ft. of superheating surface, is 72 in. in diameter outside of the front ring. It has 183 2-in. tubes and 28 5½-in. flues, which are 15 ft. in length over the tube sheets. It is of the straight-top type with the center line 9 ft. above the rail which, with the firebox set back of the drivers, gives a throat 19¾ in. in depth from the bottom of the mud ring to the bottom of the back barrel course. The firebox measures 77⅝ in. by 72¼ in. inside and has a horizontal grate 38.9 sq. ft. in area.

Heavy Six-Wheel Switcher Built for the Union Railroad, by the Lima Locomotive Corporation

These locomotives are considerably larger than the standard six-wheel switch engine design of the United States Railroad Administration, but are not as heavy nor as powerful as the locomotives of this type operated by the Terminal Railroad Association of St. Louis which were built in 1916. Reference to the comparison of the principal dimensions and ratios of the three locomotives shows, however, that the Union

Railroad locomotive has much the more liberal allowance of heating surface in proportion to the tractive force, although the proportion of firebox heating surface to total evaporating heating surface is considerably smaller.

COMPARISON OF SIX-WHEEL SWITCH ENGINES

Name of road	Union	U. S. R. A.	T. R. R. A. of St. Louis
Cylinders, diameter and stroke	22 in. x 28 in.	21 in. x 28 in.	22½ in. x 30 in.
Tractive force	42,900 lb.	39,100 lb.	45,500 lb.
Weight on drivers	182,000 lb.	165,000 lb.	198,000 lb.
Diameter of drivers	51 in.	51 in.	51 in.
Boiler pressure	190 lb.	190 lb.	180 lb.
Total evaporating heating surface	2,191 sq. ft.	1,886 sq. ft.	2,508 sq. ft.
Superheating surface	506 sq. ft.	442 sq. ft.	460 sq. ft.
Combined heating surface	2,697 sq. ft.	2,328 sq. ft.	2,968 sq. ft.
Grate area	38.9 sq. ft.	33 sq. ft.	41.4 sq. ft.
Tractive force x diameter drivers ÷ comb. heating surface	633.4	856.6	781.8
Firebox heating surface, per cent of evaporating heating surface	4.2	7.3	7.6

The tender tank is of the rectangular type and neither the tank nor coal pit is carried high enough to obstruct the vision to the rear from the cab. The tender frame is of the built-up type and is carried on arch bar trucks which are fitted with elliptical springs. The tender has a capacity of seven tons of coal and 7,000 gallons of water.

Interesting features of Union Railroad locomotives are the platforms to which access is obtained by side steps of the passenger car type, both at the front end of the engine and the rear end of the tender. The forward platform is placed over the front deck casting, with the steps placed immediately back of the cast-steel bumper, while the rear platform is carried on an extension of the underframe. Both the platforms and the running boards along the sides of the boiler are protected by railings of chain supported by columns placed along the outside of the running boards and the outer ends of the platforms.

The principal dimensions and data are shown in the following table:

Railroad	Union
Type of locomotive	0-6-0
Service	Switching
Cylinders, diameter and stroke	22 in. by 28 in.
Valve gear, type	Walschaert
Valves, piston type, size	11 in.
Maximum travel	5¾ in.
Outside lap	⅞ in.
Exhaust clearance	0 in.
Lead in full gear	1/16 in.
Weights in working order:	
On drivers	182,000 lb.
Total engine	182,000 lb.
Tender	127,200 lb.
Wheel bases:	
Driving	11 ft.
Total engine and tender	47 ft. 3¾ in.
Wheels, diameter outside tires:	
Driving	51 in.
Journals, diameter and length:	
Driving, main	10 in. by 13 in.
Driving, others	10 in. by 13 in.
Boiler:	
Type	Straight top
Steam pressure	190 lb.
Fuel, kind	Bit. coal
Diameter, first ring, inside	72 in.
Firebox, length and width	77⅝ in. by 72¾ in.
Arch tubes, number	4
Tubes, number and diameter	183—2 in.
Flues, number and diameter	36—5½ in.
Length over tube sheets	15 ft.
Grate area	38.9 sq. ft.
Heating surfaces:	
Firebox and comb. chamber	145 sq. ft.
Arch tubes	18 sq. ft.
Tubes and flues	2,028 sq. ft.
Total evaporative	2,191 sq. ft.
Superheating	506 sq. ft.
Comb. evaporative and superheating	3,454 sq. ft.
Tender:	
Style	Water bottom
Water capacity	7,000 gal.
Fuel capacity	7 tons
General data and weight proportions:	
Rated tractive force, 85 per cent	42,900 lb.
Weight on drivers ÷ tractive force	4.25
Total weight engine ÷ comb. heat. surface	52.7
Boiler proportions:	
Tractive force ÷ comb. heat. surface	12.4
Tractive force × dia. drivers ÷ comb. heat. surface	633.4
Firebox heat. surface ÷ grate area	3.7
Firebox heat. surface, per cent of evap. heat. surface	4.2
Superheat. surface, per cent of evap. heat. surface	23.1
Tube length ÷ inside diameter	90

Methods of Sampling for Material Inspection

A Study of the Application of the Laws of Chance to This Phase of Engineering Specifications

By H. M. Phillips

MANY specifications for material which are carefully drawn in all other respects are either indefinite or illogical in the method of taking samples for determining the quality of the material offered and in the procedure to be followed when a portion of the samples fail to meet specification requirements. This statement applies not only to specifications drawn up by individual engineers or purchasing agents some of which are admittedly freakish; but also to those adopted by engineering societies and by the United States Government, which are generally regarded as "standard." In the following paragraphs no attempt will be made to establish a new standard; the field is far too broad. The generalities given below, however, may contain hints that will be of assistance to specification writers.

Character of Material Should Determine the Method of Sampling

In the great majority of cases it is obviously impossible to obtain absolute assurance that all parts or pieces of the material in question are of the same quality as the samples taken for test, perhaps the only exceptions being liquid or granular substances in which the entire mass is thoroughly stirred or mixed at the time of sampling. In all other cases the possibility of a certain amount of defective material escaping detection by sampling or taking test specimens must be recognized by the specification writer, who should determine to the best of his ability the expense for sampling and testing that will be justified in order to keep the amount of defective material that will escape detection down to a definite limit. It will readily be seen that in some cases the nature of the material or the process of manufacture insures a high degree of uniformity—either good or bad—in the product, allowing the acceptance or rejection of a large order on the results obtained from a few samples. On the other hand the order in question may be composed of the product of two or more different workmen, different machines, or different melts of metal, with the result that there are a considerable number of defectives either scattered through the entire lot or segregated in one portion of it. Unless the order can be divided into lots having the same characteristics, as determined by the factors noted above or by other causes, it is better to have the material so mixed as to avoid segregation. Otherwise it will be practically impossible to obtain correct samples of the material as a whole. Where segregation is likely to exist in a single specimen, as in a casting or in billets or sheets made therefrom, one or more samples should

be taken from the part where the injurious effects of segregation are most likely to be manifested.

Specifications should be so carefully worded as to leave no possibility of a misunderstanding in regard to the method to be followed in determining whether or not the material furnished conforms to their provisions; this necessarily includes the method of sampling. They should also show clearly the procedure to be followed or penalty to be incurred in case a portion of the samples fail to come up to specification requirements. If the specifications fail in this respect, which is not infrequently the case, the result is likely to be acceptance of unsatisfactory material or controversy and hard feelings between the parties concerned. Illustrations taken from specifications in common use showing lack of proper consideration in this respect may be of interest in this connection.

Specifications Often Vague

The term "representative sample" is not unlikely to lead to difficulties; when the run of the material in question is not perfectly uniform it may be difficult or impossible for the purchaser and manufacturer to agree upon what may properly be taken as a "representative sample." In many cases where a portion of the material is undoubtedly bad, it is practically impossible to secure a single sample that may fairly be called representative of the lot. Again it may be specified that the sample, or samples, shall be "selected" by the purchaser or his representative; which is a fair assurance, at least in the mind of the manufacturer, that he will pick what he believes to be the poorest specimen in the lot. This may be satisfactory in some instances, where each piece receives individual surface inspection in the process of manufacture; but it is obviously unfair to the manufacturer in others, as in the case of screws or rivets, where it is to be expected that there will be a few defectives in any large lot. In some cases this fault may be fairly well covered by allowing the manufacturer to withdraw any sample that he is unwilling to have tested; this may be considered as an individual rejection of the piece in question, a new sample then being selected by the purchaser. A sample "selected at random" may also be satisfactory in some cases, but certainly not in all. Perhaps 25 per cent of the material is defective, or shows some peculiarity in its appearance that causes the purchaser to doubt its ability to meet requirements; must the purchaser be content with one chance in four of obtaining a sample of this material? In fact the manufacturer might be within his rights in insisting that obviously defective material be allowed to remain in a lot of material from which a sample is to be "taken at random" and compel the purchaser to accept it if it did not happen to come up in the sample.

Laws of Chance Prove Many Methods Illogical

The question of the number of samples should be studied with regard to requirements of the individual case. When the order involves a considerable number of pieces such expressions as "one out of every ten" or "two out of every hundred" are in fairly common use, a method which may answer the purpose in some cases but is nearly always illogical. If we can assume that the various units composing the lot are of uniform quality, a single sample should serve for a lot of 1,000 as well as for a lot of 10; its application to material that is not uniform may best be illustrated by an example.

Let us suppose that 10 per cent of the total number of pieces in the lot are defective, and that the defectives are uniformly distributed throughout the lot. If the lot consists of but 10 pieces there is but one chance in ten of detecting the defective material by a single sample. With larger lots, and corresponding increases in the number of samples, the probability of obtaining at least one defective sample increases rapidly, as shown by Table I.

Much greater uniformity in the chances of detection of defective material would be obtained by taking a fixed number of samples, irrespective of the total number of pieces involved. This is illustrated by Table II. If the samples

TABLE I—CHANCES OF OBTAINING DEFECTIVE SAMPLES FROM LOTS OF VARIOUS SIZES, WITH ONE SAMPLE IN TEN PIECES, WHEN 10 PER CENT OF ALL MATERIAL IS DEFECTIVE

Total number of pieces in lot	Number of samples	Number of chances in 100 of obtaining one or more defective samples
10	1	10.
20	2	19.4
30	3	27.9
40	4	35.5
50	5	42.3
60	6	48.4
70	7	53.8
80	8	58.7
90	9	63.1
100	10	66.9
120	12	73.5
140	14	78.8
160	16	83.1
180	18	86.4
200	20	89.1

are destroyed in testing it would rarely be advisable to take five samples out of a lot of ten; for such a small number surface inspection of each piece and a single sample selected by

TABLE II—CHANCES OF OBTAINING DEFECTIVE SAMPLES FROM LOTS OF VARIOUS SIZES, TAKING FIVE SAMPLES TAKEN IN EACH CASE, WHEN 10 PER CENT OF ALL MATERIAL IS DEFECTIVE

Total number in lot	Number of chances in 100 of obtaining one or more defective samples
10	50.0
20	44.8
40	42.7
60	42.1
80	41.8
100	41.6
200	41.2

the inspector would generally serve the desired purpose. It would seem well, however, to limit the maximum number of samples to a definite figure.

Further Sampling After Failure of First Selections

Specifications are frequently indefinite or illogical in regard to the procedure to be followed when samples fail to meet specification requirements. In some cases the subject is not covered at all, leaving the purchaser and manufacturer to settle the matter as best they can *after* the inspection has been made. Sometimes the specifications require the material to be divided into lots of a definite number of pieces, one or more samples being taken from each lot and in case a sample fails, the lot from which it was taken is to be rejected. This procedure might be satisfactory if there was any strong probability of the different lots possessing different characteristics due to the process of manufacture; but in the majority of cases it may be assumed that the material has been pretty well mixed, either before or during the process of dividing into lots, and that therefore the different lots are of about the same average quality. If such is the case the lots that *chance* to be rejected on account of defective samples are probably no worse than the remaining lots from which the sample *happened* to be satisfactory.

In other specifications it is provided that in case of one or more of the original samples proving defective, additional samples shall be taken, failure of the latter to cause the rejection of the lot from which they were taken. Although this method appears fairly reasonable at first glance, it offers comparatively little protection to the purchaser, as may be seen from Table III.

The chance of rejection increases quite rapidly with the number of defectives. We may as an illustration assume that in a lot of 100 there are 30 defectives, the chances of obtaining one or more of them among 10 samples is 97.8 in 100, a practical certainty. The chance of final rejection if

2 additional samples were taken for each defective, failure of any to cause rejection, is 82.4 in 100, hardly as high as might be desired for such poor material.

Specific Cases

A well known specification contains the provision that the material shall be divided into lots of 250 each, two samples to be taken from each lot, two additional samples to be taken from the same lot for each failure of the first samples taken, in case of failure of any of the second samples the lots from which they were taken to be rejected. If 50 per cent of the material in a lot is bad there will be 75.3 chances in 100 of obtaining a defective sample; but only 59.7 chances in 100 of rejecting that lot through failure of the second samples. In other words if there were 2,500 pieces, half of which were bad, they would be divided into 10 lots, each of which would presumably contain about 125 good and 125 bad pieces. The probabilities are that six of the lots would be rejected and four accepted. If the percentage of defectives rises to 60 there will be 75.2 chances in 100 of rejection, but if it falls to 10 there will be only about 4 chances in 100 of final rejection.

TABLE III—CHANCES OF REJECTION WHEN 10 PER CENT OF ALL MATERIAL IS DEFECTIVE, ONE SAMPLE BEING TAKEN FOR EACH 10 PIECES AND TWO ADDITIONAL SAMPLES TAKEN FOR EACH ONE FOUND DEFECTIVE IN FIRST LOT

Total number in lot	Number of chances in 100 of final rejection
10	0
20	2.1
30	4.0
40	6.0
50	7.8
60	9.6
70	11.4
80	13.0
90	14.8
100	16.5

If a lot of 2,500 pieces contained 10 per cent of defective material and 20 samples were taken from the lot there would be 88 chances in 100 of obtaining at least one defective; while if 50 per cent of the material were bad there would be a practical certainty. If the nature of the material allows the acceptance of a lot with a considerable number of defective, provision might be made for acceptance with a limited number of defectives in the original 20 samples, but if the limit is exceeded the assumption is that the entire lot contains about the same proportion of defectives and should be rejected. For the protection of the manufacturer, he might be given the privilege of submitting additional samples, to be tested at his own expense, the material to be accepted if the percentage of defectives in the total number of samples is brought below the specified limit.

For example, if the limit were fixed at less than 10 per cent and two out of the original 20 samples were bad, 10 additional samples might be taken and if these were all good the material would be accepted; if two out of the 10 proved bad, 20 more might be taken and if these were all good we would have four defectives in a total of 50 and the material accepted. In the above illustration it is assumed that the manufacturer is compelled to submit samples in units of 10 in order to avoid fractional percentages. It would be somewhat easier for the manufacturer if, after the first rejections, he were allowed to submit a single sample and if that proved good there would be two defectives in 21 bringing the percentage below 10 and allowing acceptance.

Unless a large number of samples be taken there is always a probability that an occasional lot containing many defectives may escape detection and an equal probability that a lot containing a very few may be rejected. The manufacturer is naturally perfectly willing that the purchaser should assume the first risk, but is strongly opposed to assuming the latter himself. Specifications with a provision for retest reduce his risk to a minimum and somewhat increase the risk of the purchaser. By rights the purchaser should have the fullest protection because his payment for defective material is liable to prove a total loss and may in some cases involve a great deal of additional expense. The manufacturer who has good material rejected can usually dispose of it with little or no financial loss.

NOTE—The method of obtaining the results given in the preceding tables is simple, though somewhat tedious even when facilitated by the use of the slide rule, logarithms, or the calculating machine. As it will be advantageous for the specification writer to apply it to various specific cases an example of its use is given here.

Assuming a total of 60 pieces containing six (10 per cent) defectives, and six samples taken; the total number of combinations that can possibly be drawn, such as numbers 1, 2, 3, 4, 5 and 6; 1, 2, 4, 5, 6 and 7; 1, 3, 4, 5, 6 and 7; 2, 3, 4, 5, 6 and 7, etc., will be

$$\frac{60 \times 59 \times 58 \times 57 \times 56 \times 55}{1 \times 2 \times 3 \times 4 \times 5 \times 6} = 50{,}063{,}860 \quad \ldots\ldots\ldots\ldots(1)$$

To find the number of combinations that can be drawn without containing any defectives, assume that the 6 defectives are removed, leaving 54 pieces from which the possible combinations are

$$\frac{54 \times 53 \times 52 \times 51 \times 50 \times 49}{1 \times 2 \times 3 \times 4 \times 5 \times 6} = 25{,}827{,}165 \quad \ldots\ldots\ldots\ldots(2)$$

Subtracting (2) from (1), we have 24,236,695 .....(3) as the number of combinations that must contain one or more defectives. There are, therefore, 24,236,695 chances in 50,063,860, or 48.4 in 100 of obtaining defectives, as shown in Table I.

For the case illustrated by Table III it is necessary to determine the probability of obtaining a given number of defectives in the first draw. To find the chance of getting a single defective, determine the number of combinations of five non-defectives to which each of the six defectives may be added and multiply by six, thus:

$$\frac{54 \times 53 \times 52 \times 51 \times 50 \times 6}{1 \times 2 \times 3 \times 4 \times 5} = 18{,}975{,}060 \quad \ldots\ldots\ldots\ldots(4)$$

The ratio of (4) to (1) is 37.90 in 100 .....(5)

The chance of obtaining two defectives is the number of combinations of four non-defectives multiplied by the combinations of two defectives:

$$\frac{54 \times 53 \times 52 \times 51}{1 \times 2 \times 3 \times 4} \times \frac{6 \times 5}{1 \times 2} = 4{,}743{,}765 \text{ or } 9.48 \text{ in } 100 \ldots\ldots(6)$$

In the same way the chances of obtaining three defectives are:

$$\frac{54 \times 53 \times 52}{1 \times 2 \times 3} \times \frac{6 \times 5 \times 4}{1 \times 2 \times 3} = 496{,}080 \text{ or } .99 \text{ in } 100 \ldots\ldots(7)$$

and four are:

$$\frac{54 \times 53}{1 \times 2} \times \frac{6 \times 5 \times 4 \times 3}{1 \times 2 \times 3 \times 4} = 21{,}465 \text{ or } .043 \text{ in } 100 \ldots\ldots(8)$$

The chances of obtaining five or six are evidently too small to be considered. Adding (5), (6), (7) and (8) gives 48.41 as a total, which checks with the calculation for Table I.

Applying the same method to the second lot of samples, with two drawn on account of one defective in the first lot, the total number of combinations possible from the 54 remaining pieces are $\frac{54 \times 53}{2} = 1{,}431$; as there are now only five defectives in the lot the chance of escape is $\frac{49 \times 48}{2} = 1{,}176$, leaving 255 chances of rejection, or 17.82 chances in 100.....(9) There were, however, only 37.9 chances in 100 of obtaining the single defective in the first draw (5), so the total chance of rejection from this cause is 17.82 of this, or 6.754 chances in 100.....(10) The method of calculation of chances in (9) and in Table I may be somewhat simplified by figuring the chances of escape as a percentage and subtracting from 100 to obtain the chance of rejection; (9) then becomes $\frac{49 \times 48}{54 \times 53} = 82.18$ per cent for escape and $100 - 82.18 = 17.82$ chances in 100 for rejection.

When four are drawn on account of two defectives among the first samples the chances of escape are $\frac{50 \times 49 \times 48 \times 47}{54 \times 53 \times 52 \times 51} = 72.82$ in 100, giving

$100 - 72.82 = 27.16$ chances in 100 of rejection.....(11) As the chances of obtaining two defectives in the first draw (6) are but 9.48 in 100, the total chance of rejection from this cause is $27.18 \times .0948 = 2.58$ in 100.....(12)

Repeating the operation for six, we have:

$\frac{51 \times 50 \times 49 \times 48 \times 47 \times 46}{54 \times 53 \times 52 \times 51 \times 50 \times 49} = 69.73$ chances for escape and 30.27 of rejections. There are, however, but .99 chances in 100 (7) of getting three defectives in the first drawing; which reduces the chance of final rejection from this source to $30.27 \times .0099 = .300$ in 100.....(13)

The chance in (13) has become so small that there is evidently nothing to be gained by going further. The total chances of final rejection through drawing either one, two or three defectives at the first trial becomes the sum of (10), (12) and (13) or 9.63 in 100, as given in Table III.

Single Sheathed Box Cars for the D. T. & I.

U. S. R. A. Design Modified to Provide One Foot Added Height and One Foot Wider Door Opening

LATE in 1923 the Detroit, Toledo & Ironton received 1,000 single sheathed box cars from the Standard Tank Car Company, Sharon, Pa., which follow very closely in the details of construction the United States Railroad Administration single sheathed cars, but have 12-in. greater clear height inside, and side doors 12 in. wider than the Administration design. These changes were made to adapt the car to the requirements of Ford Motor Company loading, and will permit the shipment of 16 Ford sedan bodies, double-decked, in one car load. The cars are 40 ft. 6 in. long by 8 ft. 6 in. wide and 10 ft. high inside. The doors have a clear opening of 9 ft. 6 in. high and 7 ft. wide.

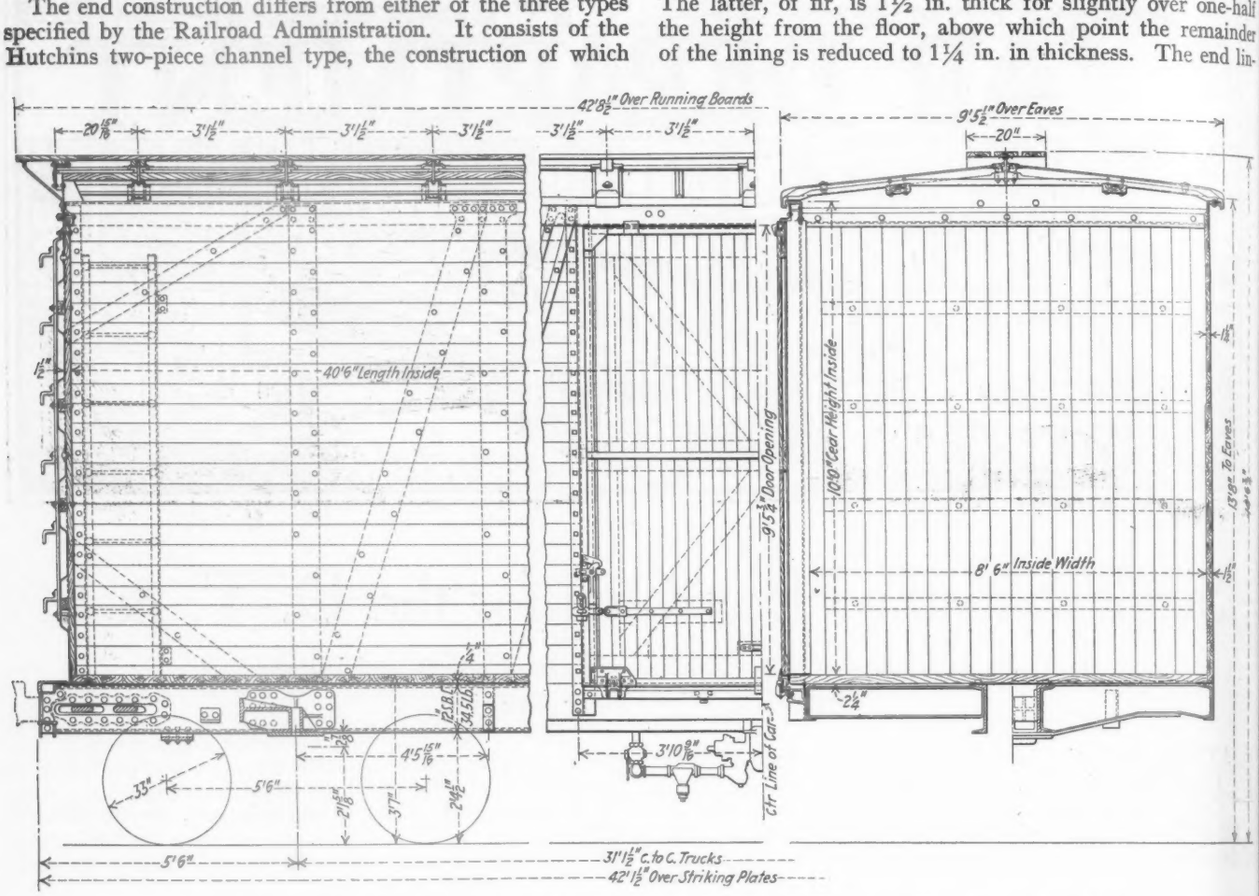
Like the Railroad Administration's cars, the underframe consists of two 12-in., 34.5 lb. shipbuilding channel center sills with two built-up crossbearers at either side of the door opening with pressed steel web members and cover plates, and built-up bolsters of similar construction. The side frame posts and braces are of pressed steel and differ from the Railroad Administration standard cars only in the reduced panel lengths between the bolster and door posts made nec-

Single Sheathed Box Car for the Detroit, Toledo & Ironton with Door Opening and Height Each One Foot Greater than the U. S. R. A. Design

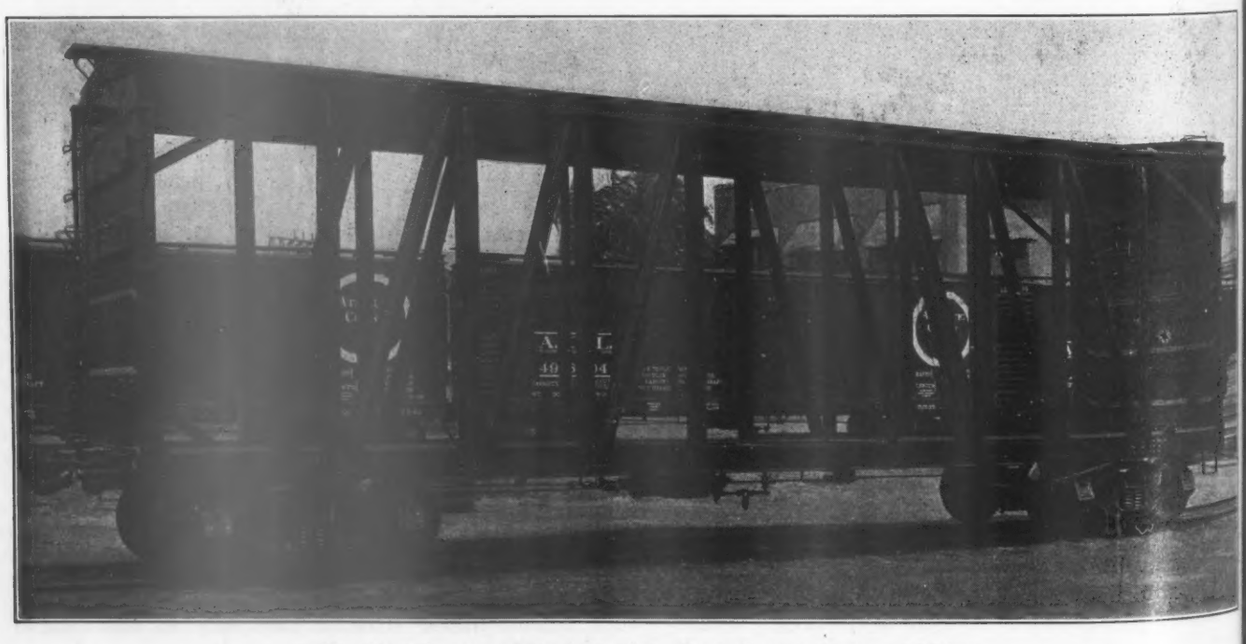
essary by the increase in the width of the door opening.

The end construction differs from either of the three types specified by the Railroad Administration. It consists of the Hutchins two-piece channel type, the construction of which includes the end plates. The cars are also equipped with Hutchins all-steel roofs. The interior of the roof is protected and provision for securing load bracing is made by two heavy longitudinal strips bolted to the underside of the carlines, each about midway between the center and side of the car.

The floor, which is 2¼ in. thick, is laid inside the lining. The latter, of fir, is 1½ in. thick for slightly over one-half the height from the floor, above which point the remainder of the lining is reduced to 1¼ in. in thickness. The end lining, which is placed vertically, is attached to the steel end panels by four horizontal bolting strips, each of which is placed between the lining and the outward projecting channel portions of the steel ends. At the bottom of the car, the end lining is gained into the floor while the upper ends of the



Longitudinal and Cross Sectional Details of the D. T. & I. Single Sheathed, Steel Frame Box Cars

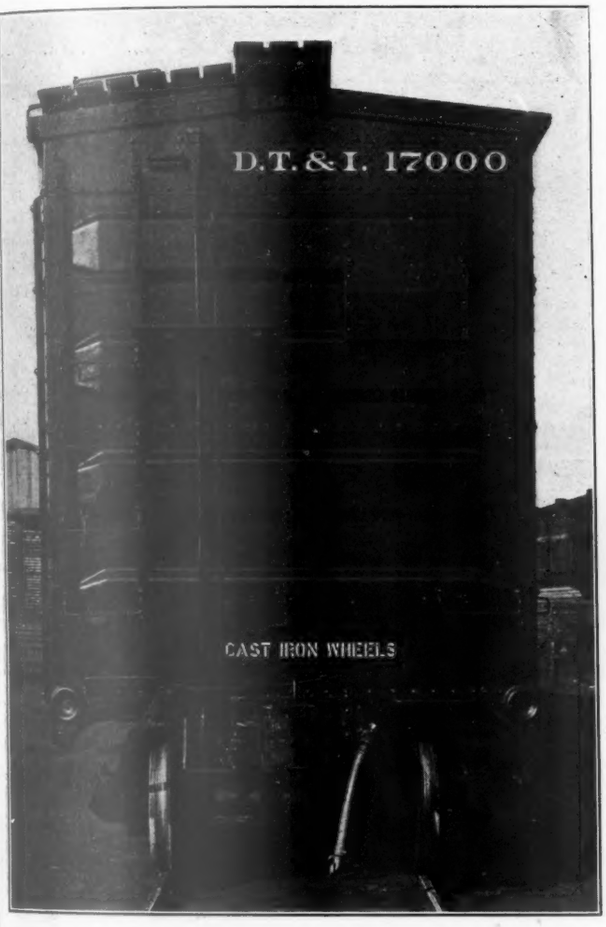


The Steel Frame and Roof Complete, Ready for the Floor and Lining

pieces are covered and held in place by a horizontal cap which is bolted to the end plate.

Like the Railroad Administration cars, the D. T. & I. cars have bottom supported doors, which are fitted with Camel No. 50 fixtures.

The trucks are of the Bettendorf type, with journal boxes cast integral with the side frames. Both the side frames and bolsters were furnished by the American Steel Foundries and bolsters are fitted with Stucki roller side bearings. The draft



End View of the D. T. & I. Single Sheathed Box Car

gears are of the Miner A-18-S friction type, with Farlow draft gear attachments. They are also equipped with the Carmer uncoupling device. The air brake equipment is operated by New York K-2 triple valves and the hand brake is the Miner Ideal lever type.

In appearance, the D. T. & I. cars differ from those of other roads in that the customary oxide red paint has been replaced by brown.

DURING THE YEAR 1922 the American Railway Express Company handled more than 184,000,000 shipments, the average weight being approximately 80 lb. These shipments had to be handled at least once at the point of origin and at least once at the point of destination in addition to handling en route. To take care of the business in New York City alone, the company requires 655 motor vehicles and 900 horse-drawn vehicles. In Chicago it has in use 648 horse-drawn vehicles and 306 power vehicles, including 25 tractors and about 60 trailers. The total vehicle equipment throughout the United States and Canada consists of 2,636 gasoline vehicles, 1,195 electric street trucks, 324 electric industrial platform trucks, 100 semi-trailers and about 8,500 horse-drawn vehicles, a total of 12,755 units. The horse-drawn vehicles average approximately 12 miles per day; electric vehicles, 20 miles per day, and the gasoline vehicles 30 miles per day.

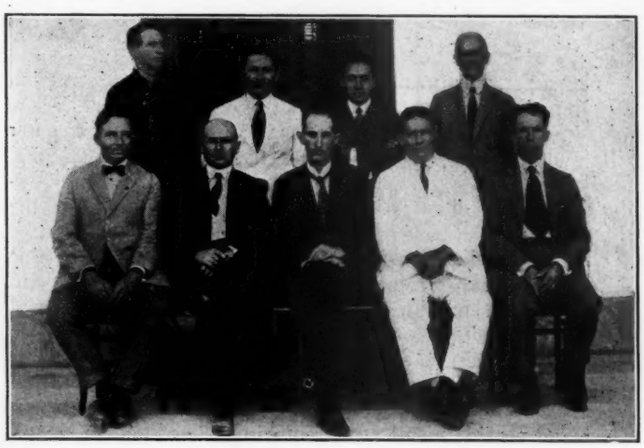
Handling Car Interchange in Cuba

By C. I. Mott

General Car Foreman, Havana Central, Havana, Cuba

FOR some time the railroads of Cuba have felt the need of a code of rules to govern the interchange of cars and the placing of responsibility for damage to equipment.

Since 1915, the United Railways of Havana, represented by the Havana Terminal Railway, had an interchange connection with the Florida East Coast through the medium of the car ferries operating between Key West, Fla., and Havana, Cuba. When this service was first inaugurated there was only one ferry a day with an interchange of 52 cars daily. At the present time the Florida East Coast has three car ferries and the daily interchange amounts to 100 cars. Since the beginning of this interchange of American cars in Cuba, the Havana Terminal has made bills for repairs to American cars, using the current A.R.A. rules.



Car Department Officers of the Cuban Railways Who Met to Consider the Adoption of the A. R. A. Rules of Interchange: Seated, left to right—Fernandez Lopez, general car inspector, Cuba Railroad; C. C. Hall, master car builder, Cuba Railroad; John Renfrew, superintendent coach car department, Havana Central Railway, Havana; C. Noya, master car builder, Norte de Cuba; C. I. Mott, general car foreman, Havana Central Railway. Standing, left to right—Rafael Sanchez, general air brake inspector, Cuba Railroad; Sr. Contrera, chief clerk to master car builder, Cuba Railroad; Sr. F. Vibarra, master car builder's clerk, Cuba Railroad; Mr. Weber, shop accountant, Cuba Railroad.

For some time the Hershey Railway, the Guantanamo & Western and the Norte de Cuba had, by common consent, tentatively employed the A.R.A. rules as a basis for handling their interchanges and for making repair bills. At the request of C. C. Hall, master car builder of the Cuba Railroad, a meeting was held at Santa Clara, Cuba, on May 8, 1923, for the purpose of eliminating from the A.R.A. rules those not applying to Cuban conditions, such as the safety appliance regulations and the regulations for the safe transportation of explosives, and of adopting the remainder for the use of all the railroads in Cuba. The modified rules were adopted by the car department officers at this meeting, subject to the approval of the general managers of the railroads involved. This approval has not yet been given.

At the present time, however, the 1921 A.R.A. rules are in general use by common consent, so far as the interchange of Cuban owned equipment between the Cuban roads is concerned. Repairs made to cars of American ownership by the island railroads are all handled under the current 1924 rules. As the Cuban railroads are not members of the American Railway Association, the Havana Terminal becomes the clearing house for all bills for repairs to American owned cars made by any of the other roads. These roads bill on the Havana Terminal, which in turn forwards the cards and bills to the Florida East Coast for collection.

Unique Car Building Contest on the B. & A.

Two Crews Tie for First Place by Completing Box Cars in a Total Time of 94 Man-Hours Each

A CAR building contest was started in the Bangor & Aroostook shops at Derby, Maine, on December 3, 1923, between two of the best crews employed at the plant. The cars being built are of A.R.A. standard dimensions, with a steel center member construction of 32 sq. in. cross-sectional area, to which are attached four cast steel draft arms, two center plates riveted to the center member, four needle beams and two body bolsters, requiring the driving of a total of 344 rivets per car. Cardwell Type G-11-A draft gears with cast steel yokes were applied, using Type D couplers. The trucks are of the arch bar type, having steel bolsters, steel spring planks and 4½-in. by 8-in. journals.

Cars of Wood Body Construction

The superstructures of the cars are of wood construction and the frame members are of Southern pine and oak. There are two 5-in. by 9-in. side sills, two 5½-in. by 7¾-in. center sills and four 3½-in. by 9-in. intermediate sills, 36 ft. long, fitted in 8-in. by 9-in. end sills. In each body frame, including the end and door posts, there are 20 posts, 16 braces, the side and end plates, 9 carlines and 2 lines of belt rail.

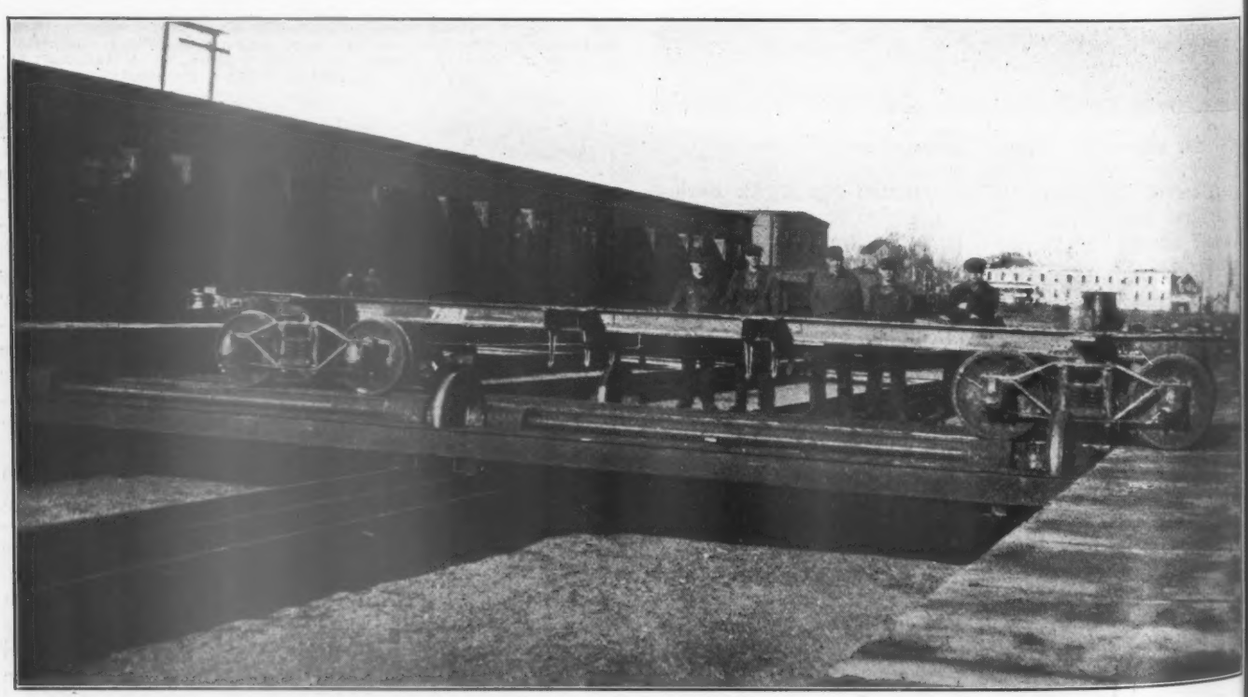
The side lining consists of ⅞-in. by 3¼-in. hard pine sheathing, while the end lining, which extends to the end plate, is of 1¾-in. shiplap spruce flooring, the same material being used for the floor. The sheathing used is 13/16-in. by 3¼-in. material, both for the sides and the roof. The entire construction required 644 ft. b.m. for siding and 324 ft. b.m. for the roof. The latter is covered with a Chicago-Cleveland outside metal roof, requiring 28 sections of metal.

The first operation was the building up of the underframe and assembling of the trucks. The underframe work consisted of the attachment of the draft arms, the body bolsters, the needle beams and needle beam brackets, the brake cylinder bracket and the center plates to the center sills. The draft gear, yokes and couplers were also assembled and applied to the underframe. This work required the driving of 344 rivets, varying in size from ⅝ in. to ⅞ in. The time required for assembling the trucks was 2½ man-hours and for fabricating the underframe, 12½ man-hours, making a total of 15 man-hours for the complete job. The work was done by a gang of one foreman and four men, who are shown with the completed underframe and trucks in one of the illustrations.

B. & A. Car No. 60677 Was Built Complete, Including Paint and Stenciling, in 94 Man-Hours

Building the Superstructure

The building of the superstructure included the applica-



The Steel Underframe Was Built and the Trucks Assembled in 15 Man-Hours; Members of the Crew, from Left to Right are J. Foster, Everett Anderson, Lawson Dickson, Burns E. Grant and Clyde Barden, Foreman

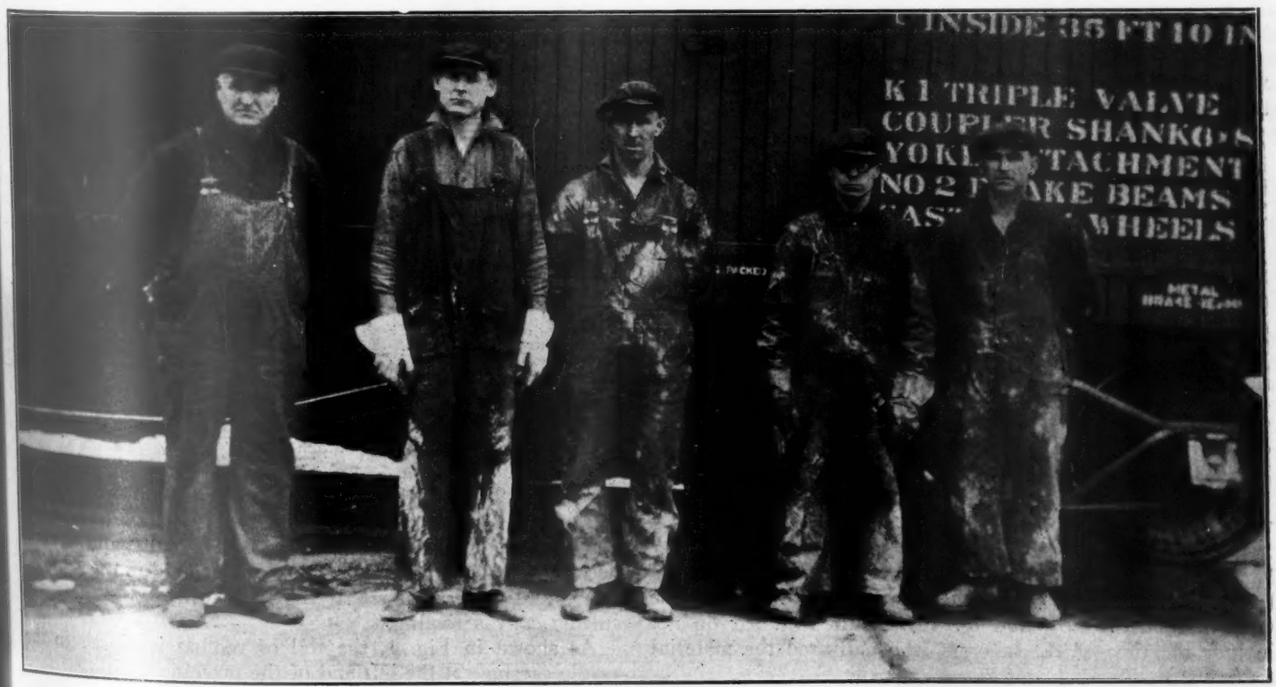
tion of the wood sills, the body frame members, the inside lining, the sheathing and the roof, and was in the hands of another gang of one foreman and four men. The operations, however, were divided into three groups. The first consisted of assembling the sills, applying the flooring and erecting the body frame complete. This work required a total of 28 man-hours.

The next group of operations was made up of the application of the belt rails and the inside lining, leaving the car ready for the application of the sheathing and roof. These operations required a total of 14 man-hours.

Then followed the application of the sheathing and roof and the painting of the car, ready for stenciling. The woodwork was completed by the car men in 31 man-hours. Added to this was 1 hr. 50 min. for the air brake work and 2 hr. 40 min. for painting, making a total of 35½ man-hours, for this group of operations.

Two superstructure crews were entered in the contest. The

This Crew Built the Superstructure of Car No. 60677 in 73 Man-Hours—Left to Right: E. W. Bailey, Foreman; Murrell Harris, Alphonse Michaud, Charles E. Buswell and John Morrill

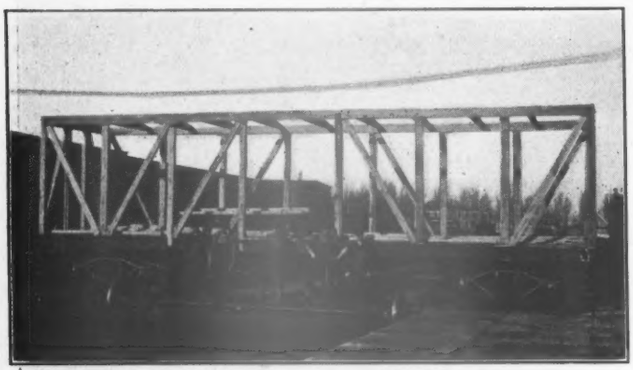


These Men Also Completed Their Superstructure in 73 Man-Hours—Left to Right: C. B. Godsoe, Foreman; Walter Chappell, S. Sherman Davis, Louis Cyr and Levi Robichaud

completed car for which the detail records are given, is shown in one of the illustrations. The complete time, including 1½ man-hours for stenciling, was 84 man-hours. A summary of the time required for the different groups of operations is as follows:

	Man-hours
Assembling trucks	2½
Fabricating the underframe	12½
Applying the sills, body frame and floor	28
Applying the belt rails and lining	14
Applying the sheathing and roof, and painting	35½
Stenciling	1½
Total time to complete the car	94

The second gang, which built car No. 60672, completed its



The Wood Frame and Floor Was Assembled in 28 Man-Hours

superstructure in 79 man-hours, including the painting and stenciling, or in 73 man-hours, exclusive of these items and the air brake work—the same total time as that required by the gang working on No. 60677. Each of the two cars required the driving of 6,308 nails, and the application of 360 bolts of various sizes.

The following is the bill of material that was used to complete each car:

Flooring, 648 board feet	30-penny cut nails, 1336
Lining, 483 board feet	⅝ in. rivets, 56
Sheathing, 968 board feet	¾ in. rivets, 100
8-penny nails driven, 3762	⅞ in. rivets, 188
10-penny wire nails, 1220	Bolts, miscellaneous sizes, 360

Conditions of the Contest

These two cars were taken from a series of 200 which were being built at the Derby shops. For their construction no special preparations or changes in methods of

The Application of the Belt Rails and Lining Required 14 Man-Hours

handling the material were made. All material was delivered to the tracks on which the different stages of the work were performed, and the man-hours recorded do not include the time of the laborers who delivered the material to the shops.

No special provisions were made for additional or extra facilities in completing this work. The trucks and underframe were assembled on one track and the superstructure completed on another, which was provided with a scaffold on each side at such height that workmen could take care of the top part of the superstructure without horses or other moveable staging.

The crew assembling the trucks and underframes was provided with an oil rivet heater and air hammers; the crews working on the superstructures were provided with air boring machines. Aside from these tools, no other machinery was used. The cars were mechanically painted and hand stenciled according to the standard of this road.

The shop in which these cars were constructed has a cement floor and all cars had to be moved from one track to another by transfer table. From the time the trucks were started, the cars were placed on three different tracks before being completed. The time required for these movements is not included in the record since none of the men employed in building the cars have any part in handling them to or from the transfer table.

Machine for Cutting "Mule Hide"

By W. W. Warner
Works Manager, Youngstown Equipment Company

A MACHINE for cutting prepared canvas roofing for passenger cars and cabooses, was recently built at the Kent, Ohio, shops of the Youngstown Equipment Company. The old method of doing this work was to roll the material out on the floor and cut it to the proper dimensions with

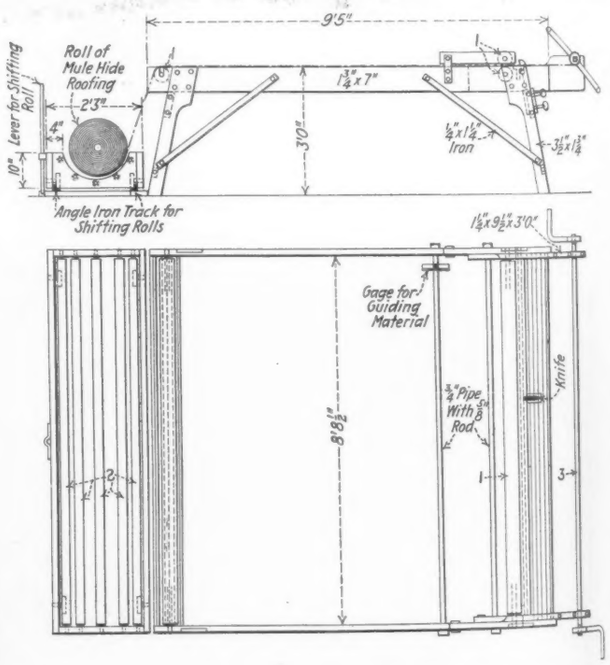


Fig. 1—This Drawing Shows How the Roofing Is Run Through the Machine

a knife. This method required considerable floor space, which was badly needed and also took a lot of time. The machine was devised to eliminate this difficulty and since it has been in operation, the work can be performed more easily and in less than half the time formerly required for cutting canvas roofing.

As shown in Fig. 1, the roll of roofing is placed in the cradle carriage at the left end of the machine. This carriage is equipped with rollers so that the roll of material will revolve easily. The cradle is placed on four small rollers that

run on an angle iron track so arranged that the carriage can be shifted back and forth. Because the material is not evenly rolled, it is necessary to shift the roll in order to keep it against the guide, which regulates the width of the strip that is to be cut. The roofing is drawn up over the top roller at the left end of the frame and thence across to the right end and passes between the two wooden rollers at 1, Fig. 1, and continues through to the roller marked 3. A handle is attached at either end for rolling up the material that has

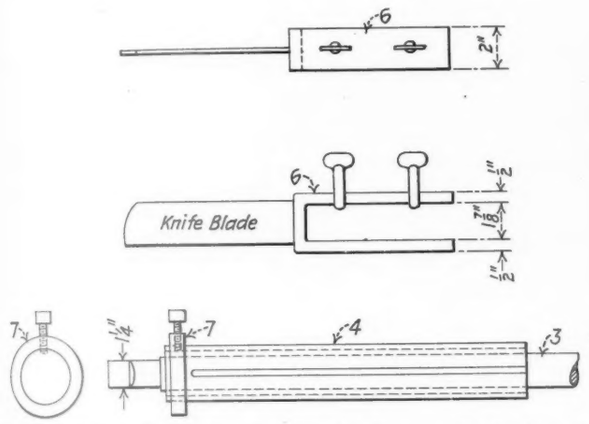
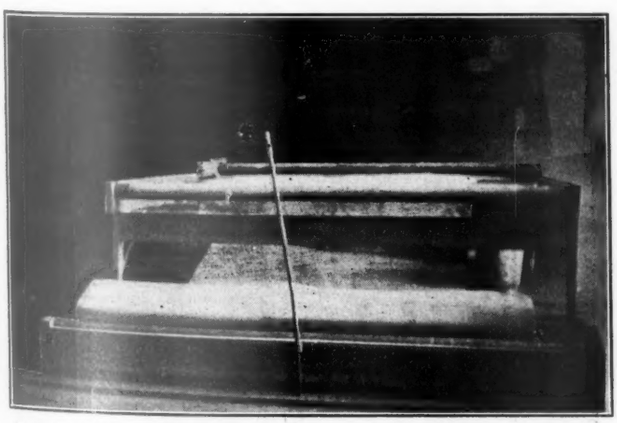


Fig. 2—Detail of the Knife, Showing the Manner of Attaching It the Machine

been cut. The scrap material can be rolled on another sleeve or allowed to drop to the floor. The large pieces can be saved for repair work or otherwise disposed of.

A loose sleeve is placed over the roller, 3, Fig. 1, to take the end of the strip in order to hold the roofing while it is being wound around the roller. This loose sleeve is fastened to the roller by means of a set screw. Sleeves of different lengths are furnished, depending on the width of the material that is required. The knife, Fig. 2, is adjustable and is fastened by means of set screws to a bar on the right end of the frame so as to cut the material as it comes from between the two rollers. If the material furnished is wider



A Roll of "Mule Hide" Being Run Through the Cutting Machine

than required, two knives can be used so that two strips for the sides of a passenger car roof can be cut at one time as the operator may desire.

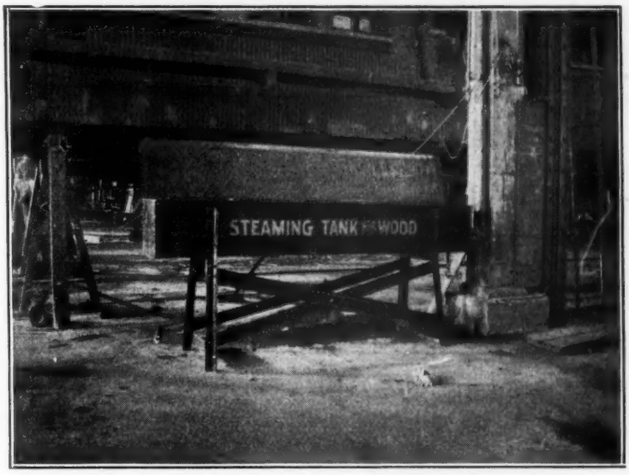
By measuring along the surface of the material at the top of the frame, the length can be ascertained as it is being wound up. After the roofing is cut to width and length, and then rolled, the set screw which locks the sleeve on roller 3, Fig. 1, is loosened and the roll removed. It is then ready to be taken to the car, where it can be unrolled and applied.

Steaming Tank for Wood

By Michael Piasecki

Assistant Carpenter Foreman, Chicago, Milwaukee & St. Paul, West Allis, Wis.

THE illustration shows a device that is being used successfully in the coach shop of the Chicago, Milwaukee & St. Paul, at West Allis, Wis., for the purpose of bending wood to be used on the hoods of passenger or express cars and



A Handy Device for Coach Shops

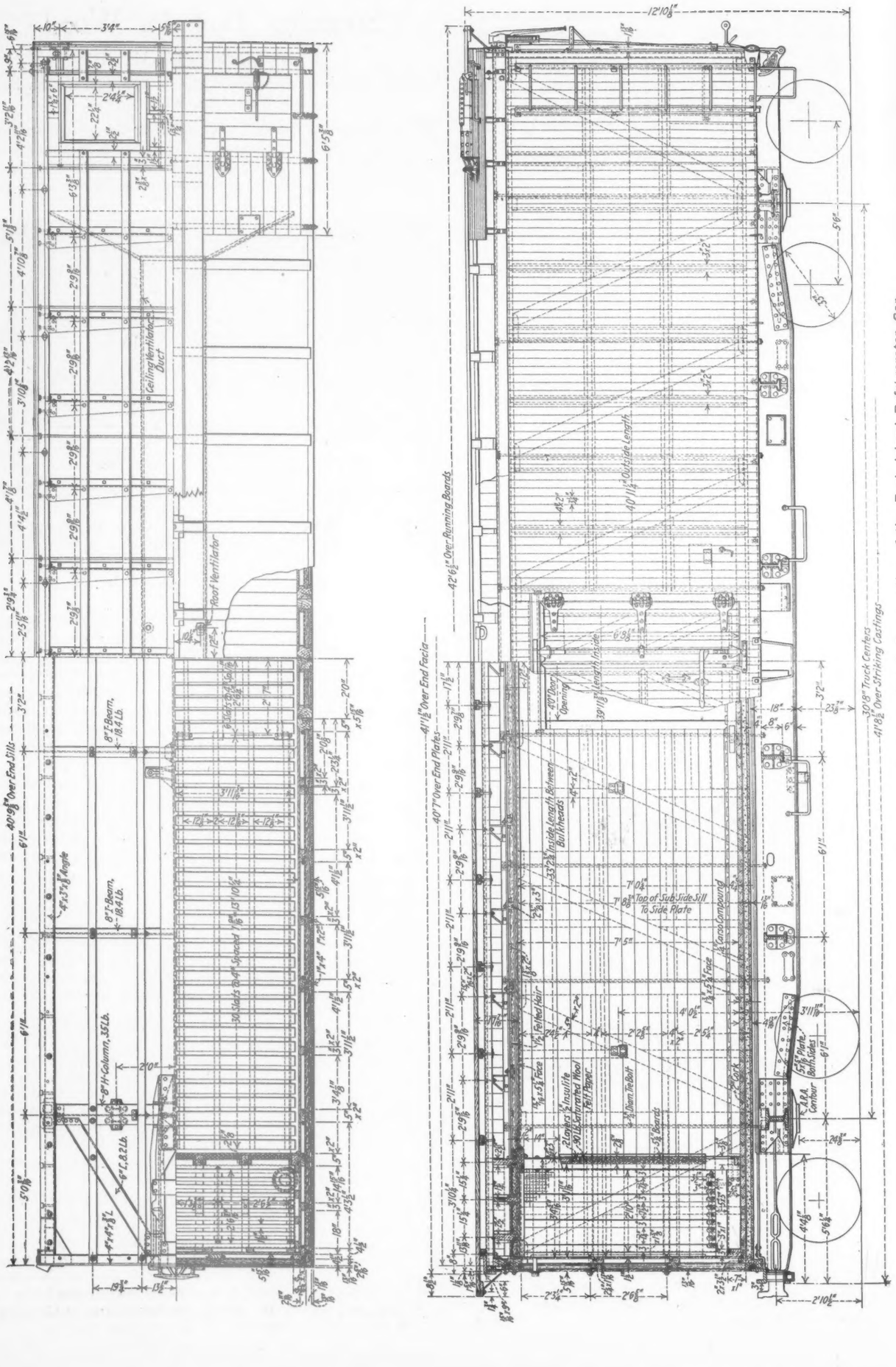
also for bending the molding used to hold the glass in oval windows. All of this work was formerly done by hand, and as a result 75 per cent of the roofing material would break while being applied. This wasted considerable material and required 16 hours of labor to complete a job of this nature on a car roof. Since this device has been placed in service the material formerly wasted has been saved and the amount of time formerly required has been reduced to five hours.

The device consists of a tank which is constructed of No. 10 gage iron. The frame is made of heavy 2-in. angle irons well braced and securely riveted. A ¾-in. perforated steam pipe for supplying the steam is run the entire length of the tank. After placing in the tank the wood that is to be bent the steam is turned on for 20 minutes. At the end of this time the material is ready for bending.

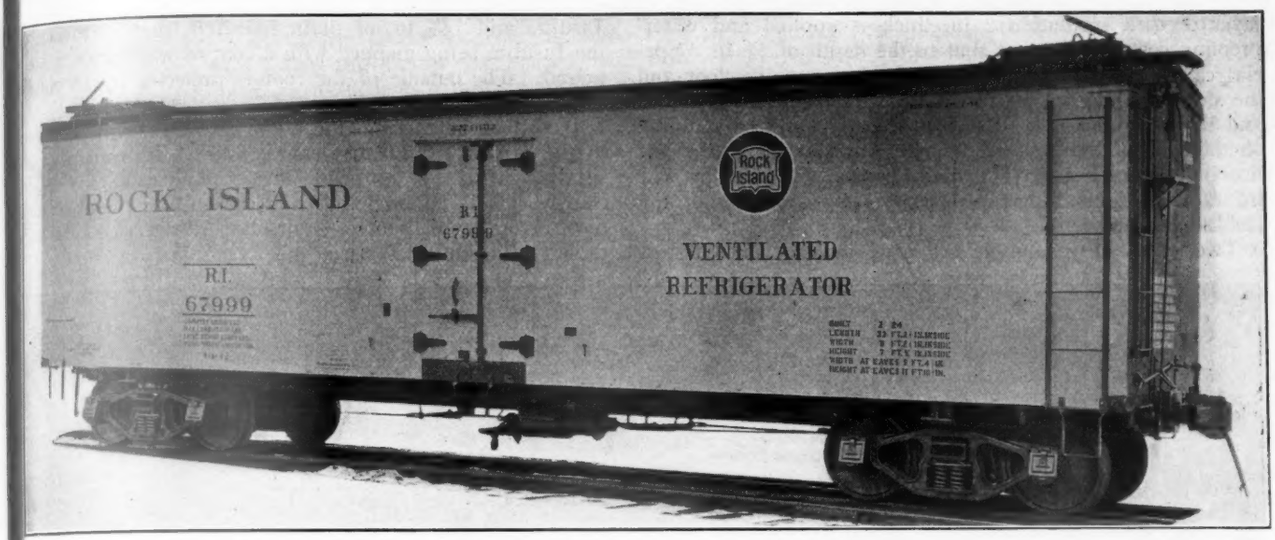
STANDARDIZATION of industrial production has been one of the important factors in enabling Germany to maintain its industrial machine intact, in the face of the multitude of obstacles now confronting that country, states a recent bulletin of the American Engineering Standards Committee.

An example is cited of the efficiency of national standardization as it has been developed in Germany, in the case of a rush order placed with German manufacturers for 200 locomotives for delivery to Russia. Production of different parts was allotted to 17 different manufacturers to be produced strictly upon the plan of interchangeable parts, no one manufacturer making a complete locomotive. The inspectors made a striking test of the feasibility and accuracy of the plan by ordering a complete locomotive to be assembled from parts chosen at random from the parts furnished by the 17 manufacturers. It proved to be ready for service immediately after assembly without the necessity of any disassembling for readjustment.

Standardization engineering is now said to be a recognized profession in Germany. The rapid development of standardization organizations within the companies has made a large demand for such work. An interesting development of the last few years is the appearance of consulting engineering firms specializing in standardization work. There are now five such firms in Germany.



Side Elevation and Plan Drawings Showing the Detail Construction of the Rock Island Refrigerator Car

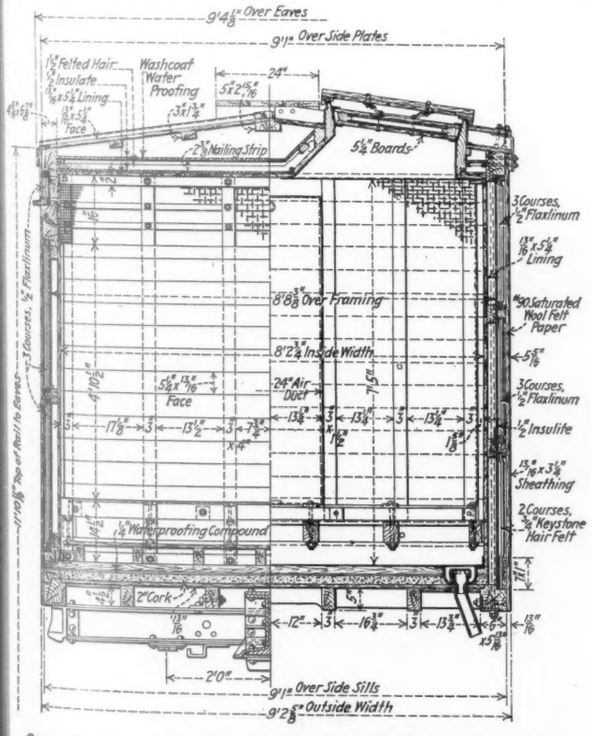


New Refrigerator Car Built for the Rock Island by the General American Car Company

New Refrigerator Cars for the Rock Island

Improved Side Construction Has Reduced Maintenance Costs and Improved Refrigerating Efficiency

AN order of 250 refrigerator cars has recently been delivered to the Chicago, Rock Island & Pacific by the General American Car Company, Chicago, Ill. These cars are being placed in regular service as soon as received and represent additional new equipment that the Rock Island has purchased to improve the quality and amount of its refrigeration service to patrons shipping fruit, vegetables and other perishable food products.



Cross Section of the Car Showing the Method of Insulating

The designers have incorporated in the cars a number of new features in the method of insulating the outside of the car and in the system of ventilation. The usual dimensions used in building refrigerator cars in recent years have been followed throughout. The height from the rail to the top of the running board is 12 ft. 10⅛ in. The end sills are built flush with the ends of the car and the distance over the striking castings is 41 ft. 8½ in. The inside length between the bulkheads is 33 ft. 2¾ in.

Insulation Massed Together

The new refrigerators are equipped with Bettendorf trucks and underframes; the superstructure is of wood and the outside roof of steel. Particular attention has been paid to getting maximum efficiency from the insulation, and, in line with recent investigations, it was decided to mass the insulation material rather than apply it in layers with air spaces between. Experience has shown the difficulty of keeping the walls of dead air spaces tight in movable structures such as refrigerator cars, and unless these walls are tight so as to prevent all circulation of air, the effectiveness of the air spaces as an insulating medium is largely destroyed.

Massing the insulation on the outside of the car also simplifies repairs, and is a particular advantage in case the car is side swiped and the sheathing and insulation damaged without piercing the inner lining. Repairs can then be made much more easily than if the insulation is split, part being on one side and the remainder on the other side of the posts.

Another advantage of massed insulation on the outside of the car is that it permits the location of the side framing about 2 in. in from the edges of the sills, thereby giving a stronger construction and one which provides less possibility of the post and brace castings being crowded out by a bulging load.

Reference to the drawing, which is a cross section through the center of the car, shows in detail the insulation used on floors, sides and roof. Above the 13/16-in. blind floor a

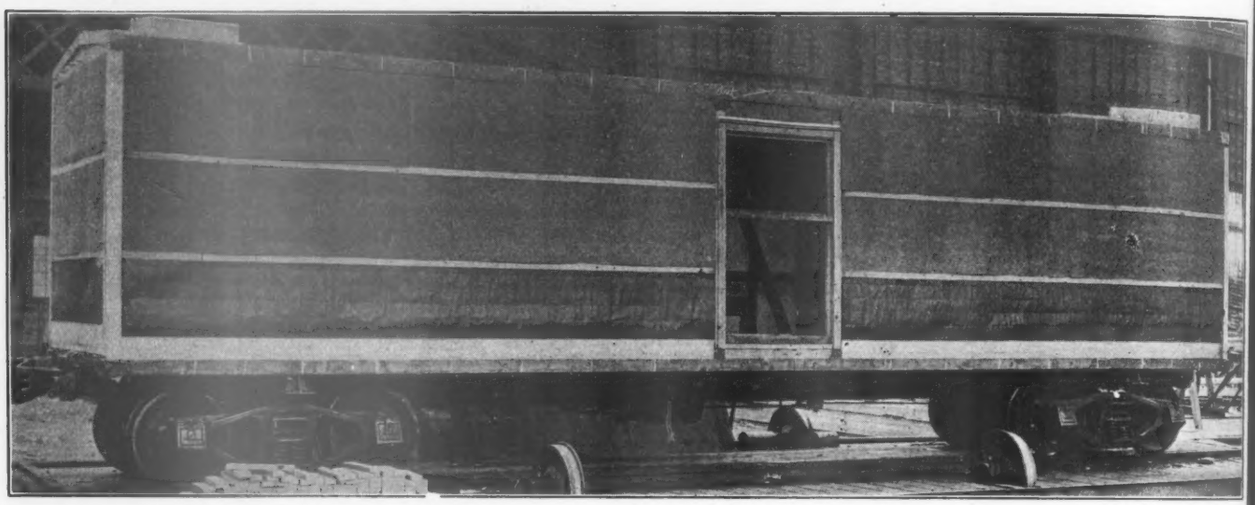
Side Elevation and Plan Drawings Showing the Detail Construction of the Rock Island Refrigerator Car

layer of cork insulation 2 in. thick is applied and waterproofing compound covers that to the depth of ¼ in. Special care has been taken at the sides between the floor and the side insulation to fill this space with insulating material and to waterproof it so that even though water be standing on the floor of the car it cannot get down at the end of the flooring to cause rot. The main flooring, 1¾ in. by 5¼ in. face, is applied over a layer of paper on top of the insulating material.

Two types of insulation are used on the car sides as indicated in the drawing and one of the photographs. One layer of ½-in. Insulite covers the entire side of the car, taking the place of the usual ⅜-in. blind lining. It is applied next to the posts and braces. This adds considerably to the stiffness of the side walls. The car sides up to the lower belt rail are covered with two courses of ¾-in. Keystone hair felt. Three courses of ½-in. Flaxlinum are applied to the car sides above the lower belt rail. The car doors, shown in cross section on the left of the drawing, are also insulated with one layer of ½-in. Insulite and three courses of ½-in. Flaxlinum.

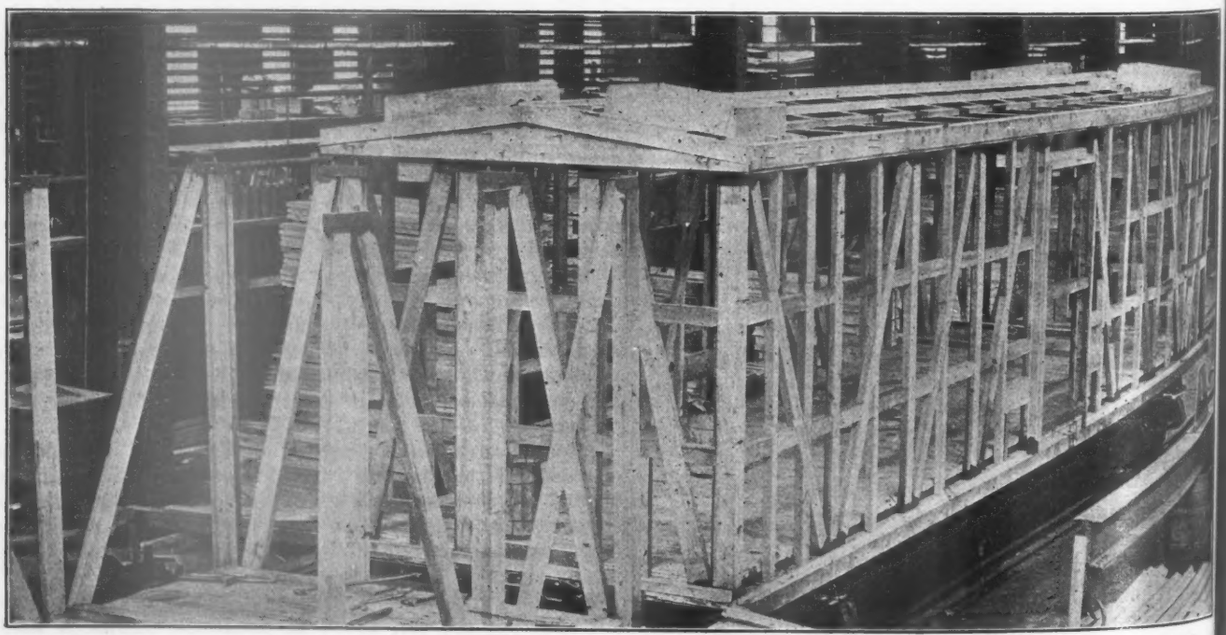
The roof is thoroughly insulated with two courses of ½-in. Insulite and 1½ in. of plain hair felt, the top surface of the Insulite being mopped with a coat of waterproofing compound. The outside of the roof is protected by an outside metal roof.

It will be noted from the above that the floors and sides of the car have the equivalent of four ½-in. courses of insulation while the roof has the equivalent of five ½-in. courses. It is believed that this car will be found to compare favorably with other high class refrigerator cars built recently for similar service.



Two Courses of Hair Felt Are Used Up to the Belt Rail and Three Courses of Flaxlinum Above

Basket-type ice bunkers are used and the hatches are of the Emerick design, which permits of more easily filling the ice boxes to the top. The Sessions type K-4 draft gear is used on one-half of the cars and the Miner class A-18-S draft gear on the remainder. All of the cars are equipped with Farlow draft attachments, Chicago-Cleveland Mullion type outside metal roofs, Klasing hand brakes, Kass safety tread steel brake steps, Miner door fasteners. The side and end ladders are made by the Wine Railway Appliance Company. The car is also equipped with floor racks which can be turned up against the side of the car for cleaning or when handling ordinary freight.

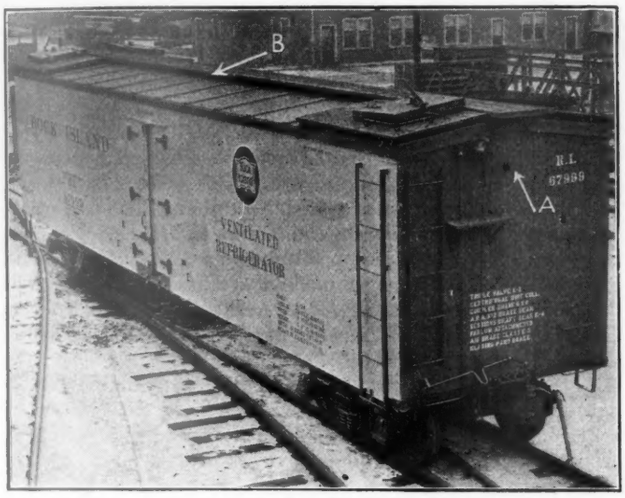


This View Shows the Flooring, Insulation and Method of Applying the Roof

Several operations in the construction and assembly of these cars are clearly shown in the illustrations. One view indicates how the posts and braces are erected, and how the roof, assembled on the floor as a unit, is applied on top. Another view shows the different insulation above and below the lower belt rail.

Acme Ventilation System Used

Another feature of the new Rock Island cars is the ventilating system, developed by the Acme Refrigerator Corporation, Chicago. This system, a description and drawing of which appears in the August, 1920, number of the *Railway Mechanical Engineer*, is not new having been first applied to an experimental refrigerator car in 1920. The correctness



An End View of the Car, Showing Some of the Specialties; (A) Is the Inlet and (B) the Outlet of the Acme Ventilating System

of the principle involved has been demonstrated in subsequent applications to other refrigerator cars, cold storage rooms and Rock Island dining car refrigerators, on which it is standard.

The Acme System is designed to allow gases, heat and moisture from perishable food products to escape by means of two small ventilators in the top of the car without interfering with the normal processes of refrigeration and air circulation in the car. In the usual construction these gases are found stratified in the upper part of the car close to the ceiling and because of their less density they can be eliminated by the proper means at the highest point. Gases from the food products are said to have a strong affinity for water vapor, and therefore in escaping carry with them a considerable amount of moisture which would otherwise promote decay. The result is a strong tendency to prevent moisture and mold from forming on such products as meat, vegetables, berries, etc., when these are shipped long distances.

As applied to the Rock Island refrigerator cars this ventilating system consists essentially of two units, one for gathering and discharging the gases mentioned, and one for equalizing atmospheric pressure and admitting enough air to balance that which escapes. One inlet *A* (shown in one of the illustrations) is provided in each end of the car, and there are two ventilators or outlets, one of which is shown at *B*, under the running board near the center of the car.

The gathering unit consists of a shallow galvanized iron ceiling duct, open at both ends near the ice bunkers at points where the gases are said to reach their highest temperature and exert the greatest pressure. Atmospheric pressure, having been equalized at a lower point, the gases pass through the ceiling duct toward the center of the car and are thence allowed to escape through the ventilators. These ventilators are slightly off center with respect to the center line of the car and the openings to them from the ceiling duct are staggered so as not to present too direct an opening to the atmosphere.

To equalize atmospheric pressure and supply an equal weight of cold air, the inlet *A* is connected to a shallow metallic air-tempering can, secured to the end lining of the car back of the ice bunker and extending nearly to the drip pan. The air from the outside entering this can and traveling downward precipitates its moisture on the cold metal, and is pre-cooled so that it enters the car both dry and cool. The small volume of air entering indirectly is thus automatically controlled by the elimination of gases and water vapor by natural means.

The result of the operation of this ventilating system is said to be the elimination of gases and excess moisture, thus tending to provide a circulation of cold, dry air which is most effective in preserving perishable food products. Keeping the interior lining and insulation dry will also have a tendency to prolong the life of the car. In view of the number of Rock Island refrigerators which are to be equipped with this ventilating system it will be tested under practically all kinds of service conditions. The results of these service tests and the extent to which they substantiate claims made for the system will be watched with interest by railroad men in both the operating and mechanical departments.

Handling Tank Cars Under Rules of Bureau of Explosives*

(After some brief remarks by E. J. League, Chicago, and Thos. O'Donnell, St. Louis, representatives of the Bureau of Explosives, the following discussion took place.—Editor.)

A. C. Campbell (N. Y. C. & St. L.): I would like to know what is being done at interchange points about removing placards from empty tank cars that were loaded with gasoline. In our district, we are having them come in with the placards not removed.

Chairman Armstrong: For the Atlantic gateway, I can say that on the failure of the consignee to remove the card, as prescribed by the Bureau of Explosives and also by the A. R. A. rules, the handling line or delivering line is penalized.

T. S. Cheadle (R. F. & P.): We have the same condition in my part of the country. I believe, from the condition, somebody thinks they have removed the placard when they have put some paint over it or have run a sharp stick through it. As I understand the last interpretation given by the Bureau of Explosives, it is compulsory that we remove the placard and not paint it over or cancel it. I would like to ask one of the chief inspectors to verify my opinion.

Thos. O'Donnell (St. Louis): If the placard is painted in such a manner as to remove the trace of its identity, painting will do. The regulations for the transportation of explosives will be satisfied if the painting is such that it cannot be recognized as an inflammable placard.

F. A. Eyman (E. J. & E.): I would like to ask why that rule for removing placards from empty tank cars, which have contained dangerous articles such as gasoline or acid, was issued. Doesn't the practical man understand that a lot of those cars that they say are empty are still very dangerous?

Chairman Armstrong: The regulations for the safe transportation of explosives and other dangerous articles are issued by the Interstate Commerce Commission, warning you that all tank cars, when empty, are dangerous, whether they were previously placarded or not. The general rule in the transportation of dangerous articles is to remove labels and

*Abstract of a discussion at the convention of the Chief Interchange Car Inspectors' and Car Foremens' Association, Chicago, October 3, 4 and 5, 1923.

placards from packages that are empty. Under the interpretation, a tank car is a package; therefore, it was the great outstanding exception to the rule. Placards were allowed on tank cars that had previously contained dangerous liquids, but after fifteen years of experimentation, the Bureau of Explosives found that tank cars, when empty, even though they did not formerly contain dangerous articles, were dangerous.

To have some empty tank cars placarded "inflammable" and not have other empty cars placarded and know they were dangerous, brought about a condition of confusion. Therefore, knowing that any empty tank car was liable to contain dangerous inflammable gases, it was decided that the safest way was to treat them all alike and remove the placards and put a warning in the Interstate Commerce Commission regulations, which is in there now, that empty tank cars, with or without placards, are liable to contain dangerous gases and should not be approached or entered with a light. This has made handling of all empty containers uniform, that is, all placards and labels have been removed.

Mr. O'Donnell: A few weeks ago, my attention was called by the claim department to losses occurring in the transfer of gasoline and some other light oils. After being transferred at a large interchange point, carloads were refused at destinations because of discoloration of the contents. A careful investigation showed that at a point where these cars were transferred from other cars, pumps were used and pipe lines and apparatus which were not cleaned. Consequently, after running 8,000 gals. of gasoline, as an instance, through one of these pumps, it showed a high discoloration, enough to have it refused at destination and, in the end, enough to cause over $300 claim against the terminal line.

When you connect a loaded tank with an empty one for transfer, you ought first of all to see that the empty tank car is clean, so clean as to be able to accommodate the load. You ought to know that pipes leading from the pumps or connections to the empty tank car are clean, that pump connections are clean, and that the pump itself is clean.

I found, on one occasion, that it was necessary to pump 50 gal. of gasoline through a pump before we got clean gasoline. It is far cheaper and safer and better for you to run a sufficient amount of gasoline or any light oil through the pump and salvage this oil in a barrel and use it at the shops, than to destroy or discolor the whole contents of the tank car by a hasty or ill-advised transfer.

Letter from Colonel Dunn (Bureau of Explosives)

Secretary Elliott: We have a communication here from Colonel Dunn which I will ask Mr. League to present as he is familiar with it.

Mr. League: Colonel Dunn would like, after I have read this letter, to have it discussed, and he is anxious to have the expression of the individual opinions of this Association, and perhaps, later, a resolution or something of that kind, as the sense of the body. The letter is as follows: "Recently, one of our inspectors approved the holding up and transfer of a number of tank cars with shells overdue for test, although the cars were in every other respect in proper condition for transportation. These cars were held up on the authority of Interchange Rule 3(e), although Paragraph 1007, qualified by Paragraph 3 of the I. C. C. Regulations (which take precedence over interchange or classification rules) clearly provides for the forwarding of tank cars of inflammable liquids under these conditions.

"It is evidently desirable that a change be made in this interchange rule to provide an exemption, based on Paragraph 1007. It may further be necessary to provide that empty tank cars, with shells overdue for test, may be accepted in interchange when destined to the owner or lessee to be retested."

Rule 1007 referred to there is this: "Unless they are leaking or in a manifestly insecure condition, packages of dangerous articles, other than explosives, when in transit, must be forwarded and report made. Leaking packages must not be forwarded."

Paragraph 3 of our regulations defines the word "package": "Where the word 'package' is used, it shall be understood to include all outside containers, including tank cars."

It seems strange that you should have in your interchange rules, authority to pass a car with a load, whose valves are due for a retest or having passed the date of test. Why should we permit that car to go forward under the card passed by the I. C. C. rules, and yet hold the car up because the test of the shell has expired? Why not amend that interchange rule to include the test of the shell as well as of the safety valve?

Quoting further from Colonel Dunn's letter: "It is my thought that you will have a splendid opportunity at the meeting to get an expression of opinion from many sections of the country as to what conditions justify the hazards involved in the transfer of the contents of tank cars at interchange points.

"Recently, one of our inspectors was called upon to superintend the transfer of several tank cars of gasoline, and, upon his arrival at the scene of transfer, he found that two of the cars showed no dropping of liquid from the rivets. The only indication that they were not tight was an oily stain. All arrangements having been made to transfer the lading, he did not think it advisable to order these cars forwarded to destination for fear of encouraging lax inspection of future shipments.

"Transferring the contents of a tank car of inflammable liquid is an operation attended by far greater possibilities of a serious accident than could result from forwarding to destination a tank car showing slight leakage at rivets and seams.

"The question naturally arises as to what is the proper definition of a leaky tank car. From the standpoint of comparative safety, it would seem reasonable to allow the forwarding of a tank car which was not leaking more than a total of 60 drops a minute from loose rivets and seams. In other words, if six rivets at different points on the shell were leaking at the rate of less than ten drops per minute each, the hazard of allowing the car to proceed to destination would be far less than that attendant upon transferring contents at some interchange point, or in close proximity to rails over which engines are operated, especially when the transfer has to be done by railroad employees without the supervision of an inspector of the Bureau of Explosives.

"Before making definite recommendations for changes in the I. C. C. regulations defining a leaky tank car, as referred to in Paragraphs 1007, 1042, 1043 and 1049 (c), I desire an expression of your opinion as to the desirability and practicability of definitely defining a leak. The Commission's rule that outlet valves must not permit more than a dropping of liquid with valve caps off has been a subject of much controversy in the past, and recently, at a joint meeting of the American Railway Association and American Petroleum Institute sub-committees on bottom outlets, a set of recommended rules was drafted and is now awaiting approval of the oil industry and the A. R. A. One of the rules reads:

" 'Cars must be loaded with bottom outlet caps off. If total dropping of the liquid being loaded is in excess of 60 drops per minute, cars must not be shipped until valves are repaired.' "

This rate of leakage does not indicate a condition of the valve which is liable to result in a serious uncontrollable leakage.

By furnishing a definition of a leaky bottom outlet valve, seam, or rivet, we eliminate the opportunity for differences in judgment of the individual and get down to a basis where

we can apply a penalty for failure to comply with a definite requirement.

Thos. O'Donnell (St. Louis): Colonel Dunn's letter does not ask for any more than an expression. We think that a leaking tank car, or a slightly leaking car, is a far safer proposition than the transferring of that car, and we consider it is safer to let the car go on to destination with a slight, clearly defined leak which we think cannot get worse, than to take that tank car and transfer it in a busy interchange point, perhaps under most unfavorable conditions.

Geo. Lynch (Cleveland, Ohio): I do not think that it would be wise to run a tank car leaking at the rivets, or as mentioned in Mr. Dunn's letter. The tank does not improve in service or handling and is liable to become more leaky than it is at the point of interchange.

Secretary Elliott: If I am in order, I will move that, at the proper time, we recommend to the Arbitration Committee that Rule 3 be so worded as to harmonize with the regulations of Paragraph 1007, to permit tank cars with tests out of date to run to destination and back again to the owner. I would also include in that motion that we ask the Bureau of Explosives to define what they consider a leaking tank car that is safe for further movement.

The motion was duly seconded.

T. J. O'Donnell (Buffalo): The Bureau of Explosives has put before us a logical and sensible thought. In the terminals we dislike very much to see cars transferred where there is hardly a perceptible liquid leak. In our Association we take chances on 50, 60 or 70 drops with common oil; kerosene we sometimes take chances with, but with gasoline, if there is any perceptible leak—a drop—we take no chance. That tank is held there and the superintendent or management has to determine what we will do. I would not take a chance of having a boilermaker come in and do much on a tank leaking gasoline. I am afraid of it.

F. W. Trapnell: I should judge that, for the last 15 years or longer in our territory, a car leaking gasoline at 60 to 75 drops a minute, no mention is made of it and the car is allowed to proceed. We have never had any trouble. Relative to the shell of the tank, I can see no good reason why we should transfer a car when the shell of the tank is overdue for test, any more than we should tie up the car for the safety valve test.

Chairman Armstrong: The motion is that this body go on record as requesting the Arbitration Committee to change the rules to allow a shell overdue for test to go forward to destination, and that the Bureau of Explosives, in connection with the A. R. A., define the extent to which a tank must be leaking before it is transferred.

The motion was carried.

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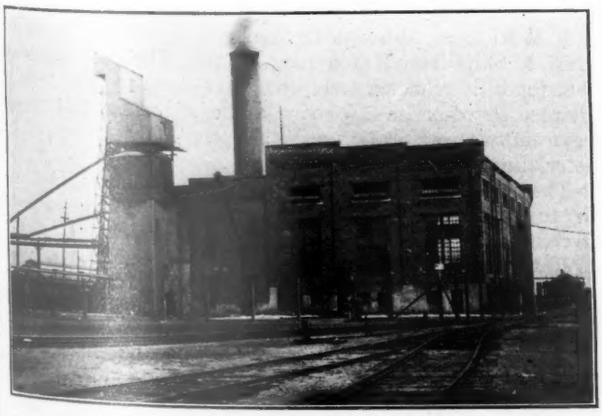


Power House at the Billerica, Mass., Shops of the Boston and Maine

Recent Decisions of the Arbitration Committee

(*The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.*)

Failure to Furnish Sufficiently Specific Information

On September 4, 1922, the Gulf, Colorado & Santa Fe furnished an inspection certificate to the Chicago, Milwaukee & St. Paul, requesting disposition of C. M. & St. P. box car 73500, located at Cleburne, Tex. In compliance with footnote to Rule 43, the handling line also advised the owner that the car had not been subjected to any of the unfair conditions enumerated in Rule 32, and that, therefore, the car was a subject for handling under Rule 120. The Chicago, Milwaukee & St. Paul declined to furnish disposition under Rule 120 on the ground that insufficient information had been furnished by the Gulf, Colorado & Santa Fe, in its efforts to comply with the footnote to Rule 43. In order to prove that its inspection certificate was correct the handling line asked that the car owner send a representative to inspect the car; however, the car owner refused as it did not consider such a procedure necessary. The Gulf, Colorado & Santa Fe claimed that the condition of the car itself was the best evidence available in support of its position, and the attention of the Arbitration Committee was brought to the owner's failure to inspect the car.

It was decided by the Arbitration Committee that the handling line, having failed to furnish the car owner specific information as required by the note under Rule 43, should assume the responsibility.—*Case No.* 1283, *Chicago, Milwaukee & St. Paul vs. Gulf, Colorado & Santa Fe.*

Making Wrong Repairs to Damaged Cars

The International-Great Northern rendered a bill for repairs during July, 1921, against the Ft. Worth & Denver City, a part of which included the application of yoke bolts to F. W. & D. C. car No. 5522. It also billed this company for repairing the running boards on cars No. 4117 and No. 4146. The Ft. Worth & Denver City objected to the charge against its car No. 5522, contending that the repairs made were not standard to this car. It also objected to the charge against its cars No. 4117 and No. 4146, claiming that the bill did not show that screws were actually used in this work and that the A. R. A. Rules did not make allowance for labor charges unless screws were used.

The Arbitration Committee decided that, "In view of yoke rivets being the standard of the car, the charge for the yoke bolts should be withdrawn. If original record of repairs shows screws as having been used, billing repair card may be amended to charge for same."—*Case No.* 1284, *Ft. Worth & Denver City vs. International-Great Northern.*

Rule 32—Car Damaged in Switching

On April 9, 1921, the Gulf, Colorado & Santa Fe submitted to the Gulf Coast Lines a joint inspection report showing a number of defects to be existent on G. S. N. O. & P. car No. 122097 at Cleburne, Tex. It also advised the Gulf Coast Lines that the defects developed while the car was being switched and that there was no unfair usage according

to Rule 32. Disposition was therefore requested in accordance with A. R. A. Rule 120. However, the Gulf Coast Lines made an inspection of this car at Cleburne and reached the conclusion that the car had been unfairly used at some previous time.

Upon making further investigation, it discovered that the car had been sideswiped at Kansas City, Mo., while on the lines of the Santa Fe and as a result, it had undergone repairs at the Argentine, Kans., shops on February 12, 1921. The Gulf, Colorado & Santa Fe claimed that the damage was due to the sills giving way and finally breaking while the car was being handled by a switch engine in a cut of cars which was being pushed up to couple on to the rest of the train. It also contended that the damage done to the car on account of being sideswiped at Kansas City was completely and properly repaired at the Argentine shops and that the reason for failure at this time was on account of the car being in a weak and worn-out condition.

The decision of the Arbitration Committee was as follows: "The original record of repairs made to this car by the Gulf, Colorado & Santa Fe, February 18, 1921, contains a notation to the effect that the metal center sills and metal side sills were broken, while the record of repairs actually made shows these metal members as having been straightened only, it being evident that proper and complete repairs were not made. It may be reasonably assumed that the impaired condition of the car, due to the unfair damage for which the handling line was responsible, contributed to the subsequent damage to the car. Therefore, the Gulf, Colorado & Santa Fe is responsible for the damage.—*Case No.* 1286, *Gulf Coast Lines vs. Gulf, Colorado & Santa Fe.*

Loss of Lading Due to Leaking Safety Valves

Tank car TIDX 114 was loaded with gasoline at the Keystone, Okla., plant of the Tidal Refining Company on June 1, 1922. Upon arrival at its destination it was discovered that the tank car was short 708 gallons on account of the safety valves leaking. The stenciling on the car showed that the safety valves had been tested at 25 lb. pressure by the St. Louis-San Francisco at West Tulsa, Okla., on May 7, 1922, and a charge covering this work was rendered against the Tidal Refining Company in the customary manner.

It was contended by the Tidal Refining Company that this charge should be eliminated and the responsibility of the loss of the lading acknowledged by the St. Louis-San Francisco. However, the handling line claimed that the owner had loaded the car at its own plant and had taken no exception to the condition of the valves when the car was loaded. It further contended that any defects which might have developed did so after the car had moved from the owner's plant and should be classed as the owner's defects, instead of wrong repairs.

The decision of the Arbitration Committee was as follows: "The St. Louis-San Francisco gives positive assurance that the safety valves on this car were properly tested and adjusted to open at a pressure of 25 lb. per sq. in. There is no conclusive evidence to the contrary at the time the work was performed. The contention of the Tidal Refining Company is not sustained."—*Case No.* 1287, *St. Louis-San Francisco vs. Tidal Refining Company.*

Owner Is Made Responsible for Car Damaged by Rough Handling

On September 5, 1922, C. S. N. O. & P. car 122166 was badly damaged in switching on the St. Louis-San Francisco at Neodesha, Kans. The handling line wrote to the car owner on October 17 requesting disposition under A.R.A. Rule No. 120. As the total cost of reconditioning the car amounted to $1,500, the Gulf Coast Lines sent an inspector to Neodesha to investigate this case. The inspector reported that the center sills were bent and broken at the body bolster and that there were flange marks on the center sills and end sill, which indicated that the car had no doubt been derailed and that it received unfair usage.

At the time of the inspection, a St. Louis-San Francisco standard bad-order card, Form M.P. 19, on which there was a notation stating that the car had been "torn to pieces by Frisco crew," was removed by the Gulf Coast inspector. A routing card was also removed which indicated that the car was in condition to carry a load of lumber on August 3, 1922, shortly prior to the damage. This evidence, with a statement calling the attention of the Arbitration Committee to the fact that the car had been handled during a strike period in the Neodesha yards and that the yard switching forces were very sympathetic to the strikers, was also submitted. As a result of the evidence collected, the Gulf Coast Lines claimed that the car was damaged by impact other than ordinary yard and terminal switching.

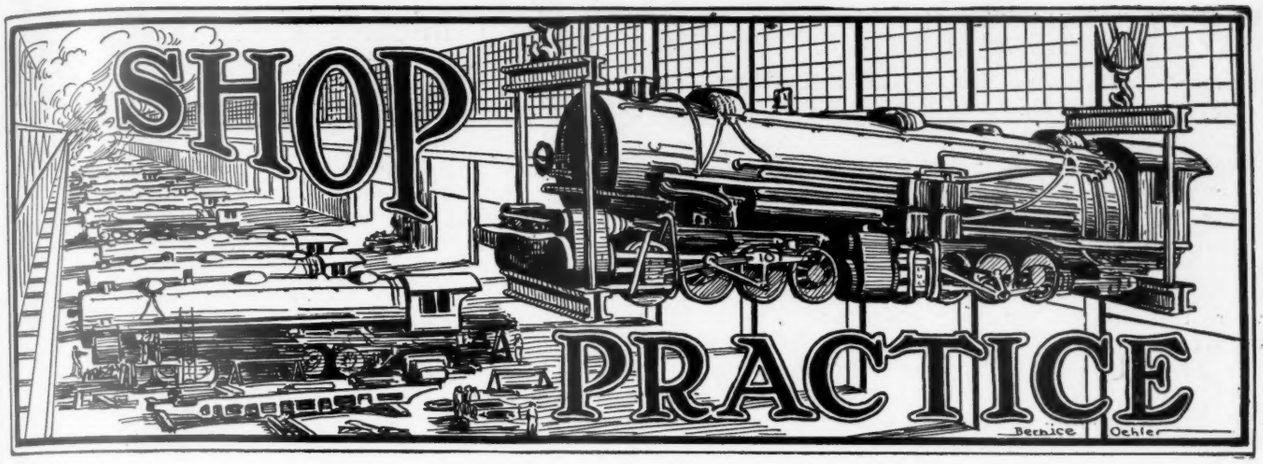
The Frisco submitted a number of affidavits made by various members of the yard crew and car department officers of the Northern division stating that the car had not been derailed, cornered or sideswiped and neither had it been in any collision or impact other than that occurring in regular switching service. It also brought out the fact that the evidence submitted by the Gulf Coast Lines relative to the car being derailed had been confused with another car, 43050, that was the property of the St. Louis-San Francisco, which had been derailed and was in no way connected with C. S. N. O. & P. car 122166. The Frisco claimed that the routing card of August 3, 1922, was no indication that the car had been unfairly handled and asked disposition according to Rules 43 and 120, contending that this case was not a proper subject for Rule 32.

The Arbitration Committee decided that there was no evidence that the car was subjected to any of the unfair conditions named in Rule 32, and that therefore the owner was responsible under Rules 43 and 120.—*Case No.* 1288, *St. Louis-San Francisco vs. Gulf Coast Lines.*

Journal Boxes Not Properly Repacked

A number of bills were rendered to the Illinois Central by the Gulf & Ship Island covering repairs to its equipment for the months of July, 1921, to January, 1922, inclusive. The Illinois Central took exceptions to certain items relating to the repacking of journal boxes on five of its cars and refused payment on all of the bills. The objection was based on a joint inspection report made by inspectors of the Illinois Central and the Alabama & Vicksburg, which stated that the journal boxes had not been repacked in accordance with A.R.A. Rule 66, although the cars bore the stencilling of the Gulf & Ship Island of a recent date. The owner claimed that the bills rendered were greatly in excess of that usually charged by other lines for similar items and for that reason payment was withheld until the proper charges could be ascertained.

The Arbitration Committee decided as follows: "According to the joint evidence statements, the journal boxes on these five cars were not properly repacked, as per Rule 66 of the 1920 Code. In fact, however, the joint inspection is not conclusive evidence that the work was not performed, with due consideration to the intervals between the dates the journal boxes are claimed to have been properly repacked by the Gulf & Ship Island and the dates of the joint inspection. Therefore, the contention of the Illinois Central is not sustained.—*Case No.* 1289, *Gulf & Ship Island vs. Illinois Central.*



Welding on Copper Fireboxes of Locomotives

Successful Results Obtained in Europe with the Oxy-Acetylene Torch and Special Filler Rods

By J. F. Springer

THE Germans have been accumulating valuable experience relative to repairs on locomotive fireboxes constructed of copper. The results achieved are of value to Americans largely because copper welding is in itself an art that is not understood by the majority of oxy-acetylene welders as well, perhaps, as it ought to be. Repairs are usually required on account of corrosion of the metal through the action of the heat in the firebox. The expansion and contraction due to fluctuations in temperature cause cracks to appear in the side and crown sheets and it is also necessary to repair the fireboxes on account of the frequent renewals of flues and staybolts and the consequent enlargement of the holes.

Under ordinary conditions copper is softer and more pliable than cast iron or steel. On the other hand, its coefficient of expansion and contraction is much greater. Its temperature of fusion is only 1,980 deg. F. and the metal is liable to undergo destructive oxidation just below this temperature.

It seems that in Germany the repairs were formerly carried out by mechanical methods. If both the front and back of the sheet was accessible the patch would be riveted on, but if the workman could get at only the front side, screws would be substituted for the rivets. As a result of the ineffective way in which the joints were made leaks were quite prevalent.

Patches on copper fireboxes are required in all sorts of locations and sometimes it is necessary to stop up some of the tube holes in order to provide a space sufficiently broad for the patch and the rivets or screws. Rivets are preferable to screws because they will keep a seam tight for a longer period. There are, however, some shops in Germany where not only patches, but even tube sheets and back sheets are secured by means of patch screws. It is also reported that the workmen did not seem to know that either bent or shortened rivets could be applied instead of the ordinary straight rivets.

The Result of Overheating and How It Can Be Prevented

Attention has been directed to the evil effects of heating copper to a point near 1,980 deg. in the presence of oxygen. The oxidized copper produced by the absorption of oxygen has a lower melting point than pure copper and will dissolve in the purer metal and corrupt it. Copper which has suffered in this way is known as burnt copper and can usually be detected by its purplish color. Its physical qualities are more or less reduced, which affects the usefulness of the metal. Pure copper, seen in a fresh break, is of a rose-red or yellow-red appearance.

The operator has the choice of two procedures in order to prevent overheating. One is the application of materials which will absorb the oxygen, and the other consists in getting rid of the oxygen which has already been absorbed. Where the metal has already absorbed oxygen, he may employ the enveloping flame produced by the torch, which is known as a reducing flame.

It is recommended that materials designed to hinder the absorption of oxygen by the copper be incorporated in the welding rod, as this will facilitate the making of equal additions throughout the welding process. There is a patented alloy composed of copper, phosphorus and silver that has been used successfully. The phosphorus is the active agent used to prevent the oxidation of the copper. It absorbs oxygen quite readily and the result is a chemical combination of the two elements, in which the phosphorus combines with the oxygen in the oxidized copper and forms phosphoric acid which escapes by evaporation.

There is also an alloy that has been patented by a Frenchman, M. Raoul Amedeo, that utilizes the affinity of vanadium for oxygen. The vanadium content is about 0.4 per cent. It is claimed that by the use of this material the big-grained structure, which is to be expected as a result of overheating of the welding region, is prevented. Furthermore, this welding rod seems to have an additional merit since it is claimed to reduce the surface tension of the molten metal, thus permitting the metal to spread promptly to all parts of the welding location.

A paste has also been developed, which is smeared over the welding location and the near by parts in advance of any welding operation. Its good results are obtained largely through the protection afforded by a film which forms over

the surface and thus prevents oxygen from getting into contact with the highly heated metal.

Importance of Proper Torch Handling

An important precaution to be considered is the manner of handling the torch. The little white flame near the tip of the burner is not permitted to come into contact with the copper. The actual fact back of this appears to be that when the mixture of C_2H_2 and O emerges from the orifice, almost immediately the acetylene breaks up into C and H and the three elements, C, H and O, flow along for a space without combining with one another. This space is approximately where the whiteness appears. Consequently, by avoiding contact of the white flame with the metal, we avoid pouring free O onto the heated metal. How far the outer end of the white flame should be kept from the copper is best ascertained by experiment.

In adjusting the flame, the operator must be careful not to provide an excess of oxygen. It will be well to be on the safe side and adjust the apparatus so that there is a deficiency of oxygen; that is, an excess of acetylene. This may be accomplished after the neutral condition has become existent by opening up with the acetylene valve or shutting off of the oxygen valve. The proper regulation may readily be found by trial. The torch should be managed so as to cover with its outer flame the portion of the seam that has just been welded.

In welding copper fireboxes, we are apt to have vertical welds. These might prove to be troublesome unless proper precautions are taken. It has already been suggested that we have the C, H and O in uncombined condition near the tip. Highly heated copper, especially molten copper, may be expected to absorb readily any available hydrogen. As the cooling continues, bubbles of hydrogen will rise towards the surface, but some will never reach it unless conditions are favorable. Thus, in vertical welds we may expect a tendency to porosity from this cause.

Wrongly Designed Torches

Experience indicates that not all oxy-acetylene torches are suitably designed for copper welding. What is wanted is a torch such that when the oxygen and acetylene supplies are once satisfactorily adjusted the adjustments will remain fixed. It may be said that in many cases heat causes a change in the proportions of the mixture of the two gases passing through the torch. This condition is undesirable. The welder of steel and iron is not greatly affected because he usually wants the normal flame and it is very easy to tell at any time whether he still has it. The copper welder wants a certain adjustment of proportions, but does not seem to have a quick, easy and sure method of correcting any departure, or even of noting whether any departures have occurred. Consequently, the burners are constructed with the mixing compartment far removed from the tip so that the supply of the two gases is influenced as little as possible by the heating of the tip. On the other hand, the heat influence still present results in an equalized action upon the acetylene and oxygen through a suitable introduction of the gases, which leads to better operating conditions.

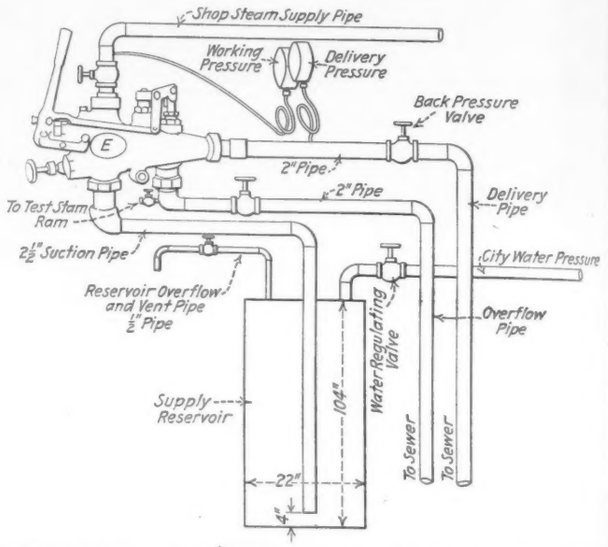
An Actual Example

In order to make sure that the reader understands the practical application of this process, let us take the case where a crack has developed between staybolt holes. The preheating and welding is done from the fire side. As this side warms up faster than the other, a bulge occurs which serves to open up the crack. Sufficient fresh metal is then added to fill the crack and at the same time allow for the bulge. Upon cooling, the sheet contracts and goes back to its previous flat condition with little or no stresses developing in the metal.

Injector Test Rack

THE testing of an injector after it has been overhauled is an important operation. Very often a locomotive which has recently been shopped has to be taken out of service because its injectors have failed to work and quite often these failures are caused by the way the injectors are tested. In some shops they are tested by air or water, which does not provide a natural operating condition for such tests.

By referring to the sketch, the reader will note that the injector is set up in exactly the same manner as it is required to function on the engine. Two gages are provided, one to regulate the pressure in the delivery pipe and the other to indicate the pressure in the steam supply pipe. Water is piped to a tank, which may be made from an old air reservoir, in order to give the injector the same source of supply as it would have if pumping water from the tank of a locomotive. The lifting capacity with certain steam pressures, as well as the amount of water discharged, can easily be ascertained by placing a barrel or tank of known capacity with the outlet pipe and operating for a definite length of time.



This Apparatus is Designed to Give An Injector a Complete Operating Test

It is found to be proper practice in testing an injector to create a pressure in the delivery pipe 40 per cent in excess of the usual working pressure. This tends to insure perfect operation when applied to a locomotive.

The delivery pressure is controlled by the back pressure valve which may be turned as desired so as to show exactly what the injector is able to accomplish.

Assortment of Non-Interchangeable Grate Shaker Bars Found at One Small Terminal

Interior View of the Erecting Shop, Buffalo, Rochester & Pittsburgh, Dubois, Pa.

B. R. & P. Has Well Organized Production Shop

Excellent Results Are Being Obtained by Efficient Management and Organization of Personnel

THE methods by which efficient and economical production has been obtained in the Maintenance of Equipment Department, particularly that of repairing locomotives at the general repair shops of the Buffalo, Rochester & Pittsburgh, located at Du Bois, Pa., should be interest to railroad shop men. These shops are of the longitudinal type, with machine bays at each side and three pit tracks in the center of the erecting shop served by two 50-ton electric cranes. As the height of the machine bays prohibits the use of overhead traveling cranes, all necessary lifting service in the machine bays is taken care of by jib cranes and overhead electric and pneumatic trolley hoists.

Limited Program of Repairs Facilitates Efficient Operation

The normal program of repairs allows but 20 engines on the erecting pits at one time, eight on each side pit and four on the center. This allotment has demonstrated its wisdom as plenty of room is thus provided for working access to the locomotives. In addition to insuring that all material is properly placed, the congestion that naturally follows when a large number of locomotives are in the shop at one time is eliminated.

No locomotive is taken into the shop except for general repairs. All non-classified and other repairs not necessitating heavy overhead crane assistance are taken care of in the enginehouses of the respective divisions. Engines which are to go through this shop are not placed on the schedule until after the boiler inspection has been made.

Routing of Locomotives and Parts

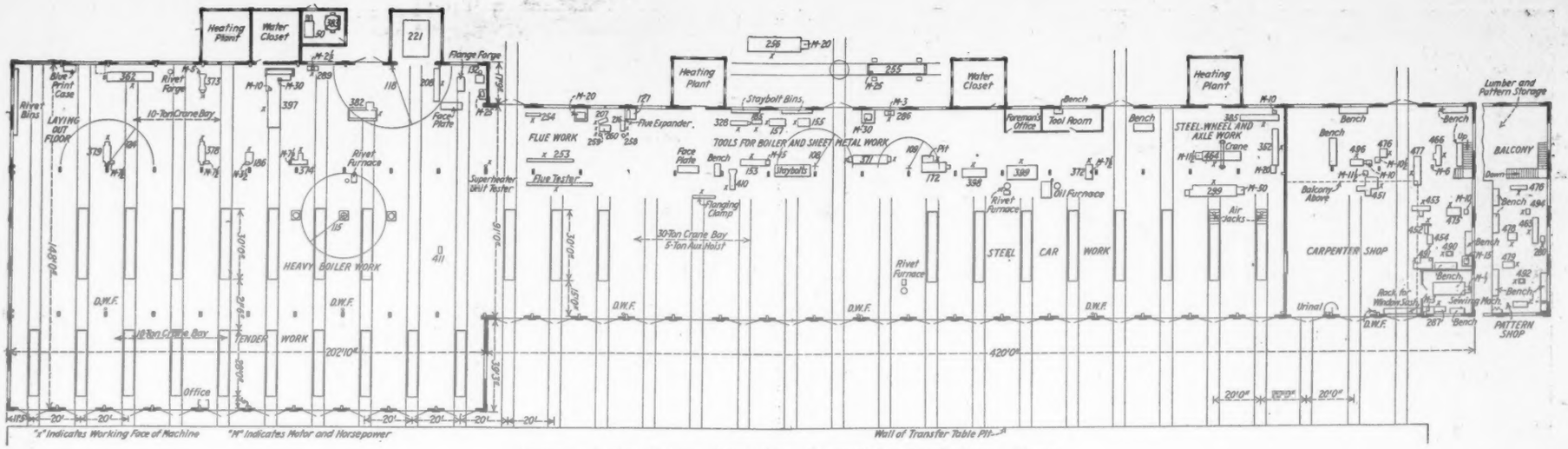
All locomotives are stripped on the center pit and set over to their assigned places on the side pits. The parts are delivered to the lye vats, after which they are routed to the various jobs to which they have been assigned.

The wheeling of all engines, regardless of the type, is done on the center pit. Wheels, complete with the boxes and with binders and wedges supported on pedestals, are placed on this pit. The shoes are then placed in position in the frame jaws and when the engine is lowered onto the boxes, the shoes, wedges and binders are automatically placed in position. This method eliminates extra movements and handling of the heavy binders. The wheeling of an ordinary locomotive can

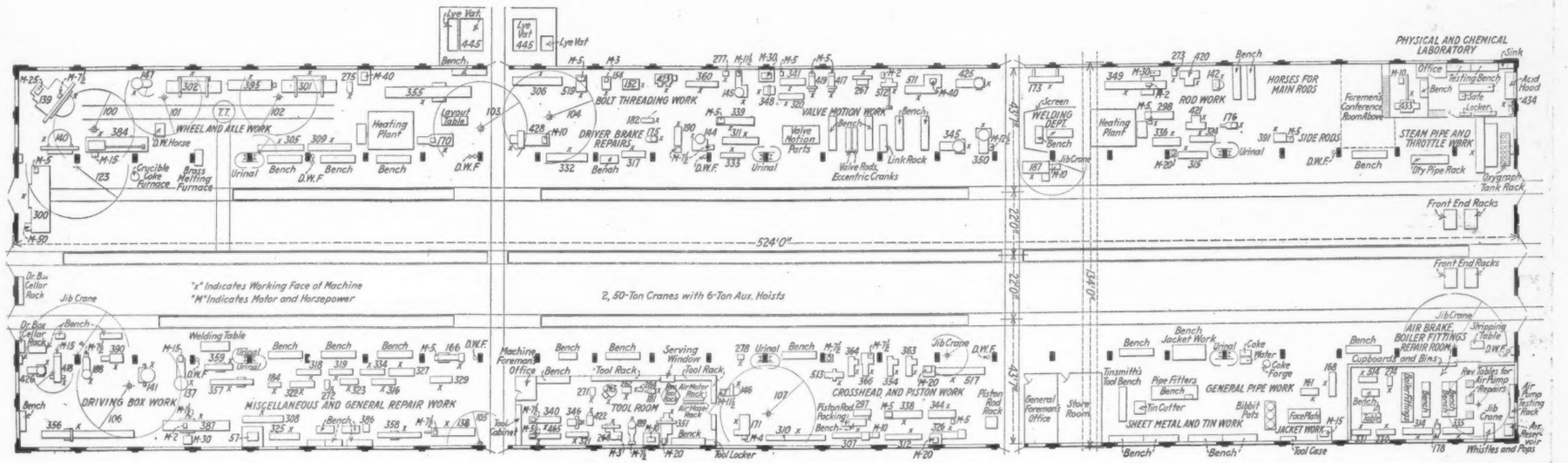
Special Attention Has Been Given to the Grouping of Machine Tools

be finished in approximately one-half hour, with all the shoes and wedges in position and binders up complete by one supervisor and four men.

The wheeling position of each locomotive on the center pit is predetermined with a two-fold object: first, to prevent any obstacle getting in the way of direct and unobstructed



Layout of the Boiler, Steel Car, Carpenter and Pattern Shops



Floor Plan of the Machine and Erecting Shop

BOILER AND STEEL CAR SHOPS

50 Duplex, 14 in. by 23/4 in. by 12 in., pump water.
62 and 78 30-hp. motors.
63 20-hp. motor.
64 15-hp. motor.
65 11½-hp. motor.
66 10½-hp. motor.
67 and 68 6-hp. motors.
69 3½-hp. motor.
374 Rotary beveling, shear, capacity 5/8-in. steel.
378 Shear, 54-in. throat.
379 Punch, 54-in. throat.
382 Hydraulic vertical flanging press.
383 Hydraulic accumulator.
385 Hydraulic driving wheel press, 84 in., 300 tons.
397 12-Ft. plate bending rolls.
398 6-Ft. open end plate bending rolls.
145 and 146 36-In. vertical boring mills.
147 48-In. vertical car wheel boring mill.
152 2-In. double head bolt cutter.
154 1½-In. double head bolt cutter.
161 3-In. pipe threading machine.
166 4-In. single head horizontal nut tapper.
168 8-In. pipe threading machine.
170, 171 and 187 6-ft. radial drill presses.
335 17-in. by 7-ft. engine lathe.
336 3-in. by 36-in. flat turret lathe.
338 and 339 18-in. by 9-ft. geared head engine lathes.
340 18-in. by 6-ft. geared head engine lathe.
341 and 344 Universal hollow hexagon turret lathes.
345 and 350 42-in. vertical milling machines.

73 11¼-hp. motor.
74 25-hp. motor.
77 5-hp. motor.
410 9-Ft. steam riveter.
411 24-In. portable pneumatic riveter.
141 51-In. vertical boring mill.
142 37-In. vertical boring mill.
144 42-In. vertical boring mill.
332 26-in. by 9-ft. engine lathe.
333 and 334 18-in. by 4-ft. engine lathes.
346 8-in. by 18-in. by 24-in. Universal milling ma-

73 11¼-hp. motor.
74 25-hp. motor.
77 5-hp. motor.
79 10-hp. motor.
83 3-hp. motor.
108 Jib crane, 16 ft. radius, ½-ton capacity.
109 Jib crane, 13 ft. radius, ½-ton capacity.
115 Portable post, crane, 18 ft. radius, 3,000 lb. capacity.
118 Post jib crane, 26 ft. radius, 1-ton capacity.
124 Post jib crane, 20 ft. 6 in. radius, 1½ tons capacity.
127 and 132 Pressure blowers.
153 Vertical 6-spindle staybolt cutter.
155 2-In. double head bolt cutter.
157 1¼-In. double head bolt cutter.
172 6-Ft. radial drill press.
185 Centering machine.
186 40-In. upright drill press.
207 and 216 Flue heating furnace—oil burning.
208 11-Ft. pneumatic flanging clamp.
221 Plate heating furnace—oil burning—8-ft. 10 in. by 14 ft. 0 in.
253 and 254 Flue cutting machines.
255 Flue cleaner, overhead type.
256 Flue cleaner, dry.
258 Pneumatic flue welding machine for superheater tubes.
259 Pneumatic flue swagging machine.
260 Flue welding machine.
280 Tool grinder—equipped with oilstone, leather and emery wheel.
286 and 289 Double tool grinder.
287 Hair picking machine.
299 28-In. by 42-in. car wheel lathe.
328 2-In. by 24-in. flat turret lathe.
352 Single head, extra heavy axle lathe.
362 20-Ft. plate planer.
371 Punch and shear, 48-in. throat.
372 Punch and shear, 20-in. throat.
373 Horizontal Punch, 8-in. throat.
399 61-Ft. plate straightening rolls.
410 9-Ft. steam riveter.
411 24-In. portable pneumatic riveter.

CARPENTER AND PATTERN SHOPS

451 Mortiser and boring machine.
452 Chain saw mortiser, ¼ in. to 1 in.
453 Single-spindle post boring machine.
454 Single spindle boring machine.
463 24-In. wood lathe.
464 40-In. engine lathe.
466 24-In. hand planer and jointer.
467 16-In. hand planer and jointer.
475 42-In. band saw.
476 and 478 Universal bench saw.
477 Swing cut-off saw.
479 32-In. band saw.
490 and 492 Portable hand trimmer.
491 Shaping and friezing machine.
494 Rod machine.
496 Tenoning machine with cope head.

MACHINE AND ERECTING SHOPS

56 and 57 40-hp. motors.
58 20-hp. motor.
59 30-hp. motor.
60 15-hp. motor.
61 10-hp. motor.
100 Jib crane, 15-ft. 6-in. radius, 8 tons capacity.
101 and 102 Jib cranes, 13-ft. 6-in. radius, 5 tons capacity.
103 and 104 Jib crane, 16-ft. 4-in. radius, 3 tons capacity.
105 Jib crane, 11-ft. 3-in. radius, 1 ton capacity.
106 Jib crane, 18-ft. radius, ¼ ton capacity.
107 Jib crane, 17-ft. radius, ½ ton capacity.
123 Electric post jib crane, 19-ft. radius, 8 tons capacity.
137 Boring and facing mill for driving boxes, 54 in.
138 Boring and drilling machine, 66-in. horizontal.
139 Boring and turning mill, 100-in. extra heavy.
140 84-In. vertical boring mill.
141 51-In. vertical boring mill.
142 37-In. vertical boring mill.
144 42-In. vertical boring mill.
173 Two spindle drill press.
175 28-In. upright drill press.
176 32-In. upright drill press.
178 24-In. upright drill press.
181 21-In. upright drill press.
182 20-In. upright drill press.
184 Centering machine.
188 and 190 42-in. upright drill presses.
189 36-In. upright drill press.
262 Drill grinder.
263 Tool grinder.
264 and 267 Universal grinders—Internal and external cylindrical grinding.
271, 272, 273, 274 and 275 Single-wheel tool grinders.
277 and 278 Two-wheel tool grinders.
284 Single-wheel chaser grinder.
297 17-In. engine lathe.
298 3-In. by 36-in. flat turret lathe.
300 Locomotive wheel lathe—Extra high power, 100-in.
301 79-In. locomotive lathe.
302 79-In. locomotive wheel lathe.
305 12-In. by 9-ft. double axle lathe.
306 42-In. by 8-ft. 6-in. engine lathe.
307 24-In. by 5-ft. 6 in. engine lathe.
308 and 309 28-In. by 8-ft. engine lathes.
310 24-In. by 15-ft. engine lathe.
311 and 312 22-In. by 7-ft. engine lathe.
314 and 315 18-In. by 6-ft. engine lathes.
316, 317, 318, 319 and 320 16-In. by 4-ft. 6 in. engine lathes.
321 16-In. by 3-ft. 6 in. engine lathe.
322 and 324 16-in. by 5-ft. engine lathes.
323 16-in. by 3-ft. engine lathe.
325 21-in. by 7-ft. engine lathe.
326 and 327 3-in. by 36-in. flat turret lathes.
329 2-in. by 24-in. flat turret lathe.
330 and 331 18-in. brass turret lathes, Fox.
333 26-in. by 9-ft. engine lathe.
333 and 334 18-in. by 4-ft. engine lathes.
346 8-in. by 18-in. by 24-in. Universal milling machine.
348 Universal milling machine.
349 3-in. by 24-in. by 14-ft. horizontal milling machine.
351 Universal milling machine, with extra heavy vertical attachment.
354 20-in. by 24-in. by 24-in. crank planer.
355 60-in. by 60-in. by 18-ft. planer.
356 36-in. by 36-in. by 20-ft. planer.
357 and 358 26-in. by 26-in. by 10-ft. planers.
359 26-in. by 26-in. by 6-ft. planer.
360 26-in. by 26-in. by 7-ft. planer.
363 and 364 20-in. by 24-in. by 24-in. crank planers.
366 24-in. by 24-in. by 24-in. crank planer.
384 96-in. hydraulic driving wheel press, 600 tons.
386 30-ton portable axle bearing press.
387 48-in. by 48-in. by 14-ft. planer, reversing motor.
390 and 391 50-ton power vertical presses.
395 Wheel quartering machine, 45-in. by 72-in., swings 84 in.
417 and 419 24-in. high duty shapers.
418 36-in. draw cut shaper.
420, 421 and 423 16-in. transverse head shapers.
422 15-in. pillar shaper.
425 18-in. slotter.
426 14-in. slotter.
428 24-in. slotter.
433 Vertical screw testing machine, 300,000 lb. capacity.
434 Hydraulic testing machine.
445 Lye cleaning vats.
465 18-in. engine geared-head lathe.
511 Grinder, 30-in. guide with 7-ft table.
512 Radius grinder.
513 Keyseating and cottering milling machine.
514 18-in. turret lathe, Fox.
517 37¾-in. by 20-ft. geared-head engine lathe.
519 2-in. double head bolt cutter.
341 and 344 Universal hollow hexagon turret lathes.
345 and 350 42-in. vertical milling machines.
385 Hydraulic driving wheel press, 84 in., 300 tons.
397 12-Ft. plate bending rolls.
166 4-In. single head horizontal nut tapper.
168 8-In. pipe threading machine.
60 10½-hp. motor.
62 15-hp. motor.
67 and 68 6-hp. motors.

movement of the locomotive out of the erecting shop, and, second, to set a definite place for the delivery of all material that is to be applied. In the majority of cases the delivery of all material is expedited in advance of the time the engine is lifted from the side to the center pit. This prevents any delay by having to wait for material, in starting to assemble the engine after wheeling.

Care has been taken in the placing of the machine tools in the side bays to eliminate back tracking, or at least to keep it to a minimum. The whole plant is laid out so that the finished work travels toward the engine on the pit.

Each Foreman Is Responsible for His Department

Special attention to the grouping of the machine tools has made the various jobs self-contained and eliminates the dependence of one foreman on another. It also individualizes the work as well as the supervision, making each foreman completely responsible for the production of the work under his jurisdiction. The value of this arrangement in production is self evident and goes a long way to make the erecting department one of stripping and assembling only, as all work comes to the locomotive finished and ready to apply.

Department Organization and Machine Tool Operation

Each sub-division or department in the machine shop is fully equipped with all the necessary machine tools and equipment to complete its particular job. The department is so arranged that a part undergoing repairs travels from one

Where the Driving Box Work Is Done

machine to another in direct rotation and always toward the delivery point of the locomotive.

From time to time machine tools are replaced with those more efficient in production in order to obtain reduced costs per unit. A number of such tools have been installed within the last three years that have fully justified their purchase. For example, a 48-in., four-headed planer was purchased, on which, by the use of a special holding arrangement, a full set of driving boxes may be planed on the shoe and wedge faces at the one time instead of having to reset, as was the former practice. A driving box boring mill was also obtained that had a universal chuck built onto the table. This machine is equipped with a facing bar for boring and facing and, as a result, a driving box can be completed in 14 min. from floor to floor. A universal guide grinder is used to true the faces of exhaust bases in one set-up, to true up faces of slide valves and other similar parts, as well as to grind guides. It does away with the many operations that were formerly re-

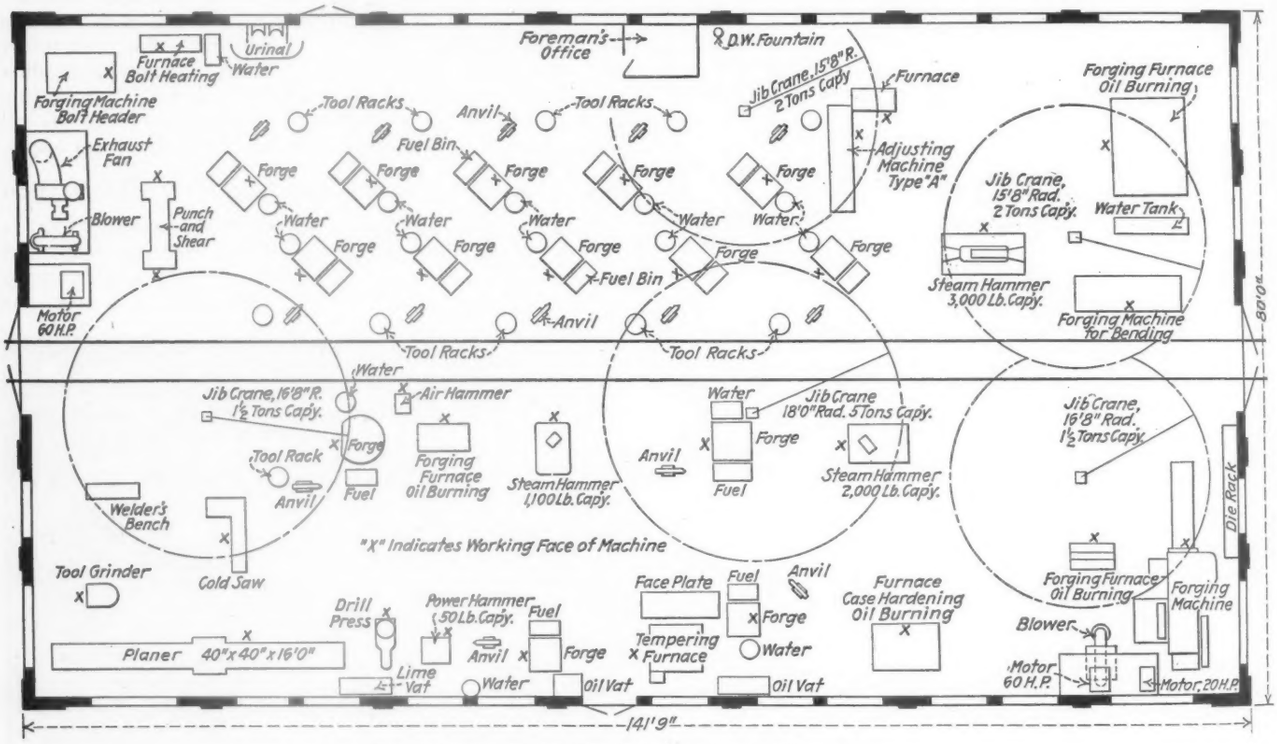
quired on a planer, slotter, and various machines of the older types; and in the case of guide work, the blacksmith shop work was also eliminated with the consequent trucking from one place to another.

Two forcing presses also constitute part of the equipment, one being used for rod and the other for driving box work. The action and capacity of these machines give accurate and quick production and the pressures are controlled instantaneously. One 100-in. vertical boring mill, which is controlled from either side with a push bottom arrangement, has reduced labor costs 50 per cent. A 28-in. slotter of the radius type makes short work of link radii and is far ahead of the planer and attachment because of its ability to take cuts, feeds and speeds to the limit of the tool steel capacity. Many machines are equipped with special devices for various operations, with

Utilizing Scrap Material

An oxygraph is installed in the south end of the erecting shop. This machine is used entirely for cutting out of the solid, main rod straps, pedestal binders, main and side rods, main rod wedges and engine truck equalizers wherever expensive operations in blacksmith and machine shop work can be eliminated. These parts are made out of scrap axles and the use of new material is thus avoided.

As an example, the production of a butt end main rod strap for a Mikado type locomotive normally requires 12 hours labor to forge and machine. With the oxygraph, the same job can be finished complete for application in three hours. A main connection side rod for the same type of engine can be produced by this machine in three hours and necessary machining accomplished in ten hours, as compared with the



Arrangement of the Equipment in the Blacksmith Shop

the object of completing the job to be done on one machine and thus reducing the handling costs.

All rod work is performed to standard tram lengths from master tram gages. A duplicate tram is used at all the enginehouses and terminals at other points on the line, which makes permanent the length for the rod when it is out of the general repair shop.

When driving boxes have been planed on the shoe and wedge faces to the limit of size, these faces are fitted with boiler plate liners, welded on, and the box is then brought back to its original size. This procedure renders it practically indestructible and makes available the use of each set of shoes and wedges for three shoppings of the locomotive.

Sub-Storeroom Provides Quick Service

In one of the machine bays a sub-storeroom is provided where stocks of small material are kept, such as standard stubs and bolts of all kinds, cotter keys, spring hanger pins, piston and valve rod packing, emery cloth, machine oil, waste and similar material. This greatly facilitates the repair work and does away with trips to the general storehouse. The shops are served with large or heavy material by an electric truck and all such material is delivered direct to the point where it is to be used.

former process of forging and finishing in thirty-two hours of actual working time.

These two examples are but typical of the work that may be accomplished by this equipment. As the torch on this device uses acetylene gas, it is necessary to anneal the part after cutting to offset any possible strains that might be set up in the operation, but from experience none of the parts thus manufactured has failed in service.

The Toolroom Is Well Equipped

The toolroom is well equipped for the handling of small tools, tool and machine repairs, as well as for manufacturing jigs and devices designed for economy and to hasten production. Hand tools are issued by a check system and are inspected weekly for errors and replacements. The toolroom force has recently developed and put into operation a device for keyseating and reaming the bolt hole in main crank pins for crank arms after setting the valves of outside gear locomotives. With this device a more accurate and finished job can be accomplished and in one-half the time that was formerly required by using a drill and chipping hammer. The machine is pneumatically driven and is powerful enough to make available the use of high speed tool steel for milling and keyseating cutters.

Foremen's Meetings Are Held Twice Each Week

Scheduled meetings of all foremen are held with the general foreman each Tuesday and Friday morning, and at these meetings various items are listed on standard unit sheets and dates for the completion of each is set. From this information the date of each engine departure out of the shop is determined. If for any reason it is found that the date originally set cannot be met, immediate notice is given to the general foreman by the foreman involved, requesting necessary changes or that other action be taken to keep the locomotive on its original schedule as nearly as possible. This system has been found to be remarkably effective on account of its simplicity. The open conferences tend to promote an intensive spirit of co-operation which makes each foreman want to do his best to maintain the scheduled date of completion of the work.

The location of the boiler, tank work and heavy repairs to steel cars, as shown on the drawings, are self-explanatory. Here, as well as in the other repairs, the reader will find the element of efficiency that should be standard to such equipment and the same general arrangement common to all the other departments.

Incidental to the foregoing, it should also be stated that 90 per cent of the manufactured material used by the entire system is made at the Du Bois shop. All rods, pistons and crossheads, mounted engine trucks, tender and driving wheels, complete, are included in the material that is furnished to other terminals.

Acetylene and Electric Welding

The acetylene and electric welding processes are both used. The former is utilized for building up worn parts and the latter for making repairs to boiler sheets, broken frames and cylinders. All new piston rods are hammered out of scrap axles. Loose fits in crossheads and piston heads are built up with acetylene, annealed and refitted for re-use. The same process is employed by using bronze and then turning to the proper size, in building up cast iron piston heads that are worn too small for the cylinder. Worn crank pins are set aside and turned down for smaller sizes. New crank pins are forged out of scrap driving axles; loose axle fits are built up, annealed and refitted to rebored wheels, and worn or sharp flanges on driving or engine truck tires are built up with the electric process. New fireboxes are applied with all seams electrically welded and the only riveting performed is at the mud rings. There are 75 of these fireboxes in service to date, including two Mallet type. Application of the side sheets, as well as boiler sheet repairs, are generally taken care of by this method. In fact reclamation of parts in this manner is general where consistent with safety and where a reduction in the expense for material can be made.

The shops are equipped with an acetylene generating plant, and all parts of the plant are piped with drop lines, thus eliminating the trucking of gas cylinders.

Shop Organization

The organization of these shops under normal working conditions is as follows:

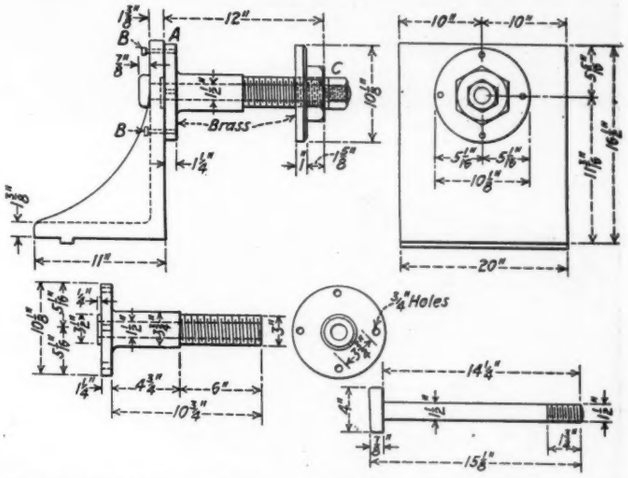
1 Superintendent of shops
1 General foreman
2 Erecting foremen
1 Machine foreman
1 Pipe and tin foreman
1 Boiler foreman and 1 assistant
1 Carpenter foreman
1 Blacksmith foreman
1 Rod and motion work foreman
1 Driving box and wheeling foreman
1 Air brake foreman
1 Painter foreman
1 Cab work and boiler mounting foreman
1 Stripping and wheeling foreman
1 Toolroom foreman

The jurisdiction of the superintendent of shops, general foreman, and boiler foreman is also extended over the 32-stall enginehouse adjacent to the shops. The total normal working force is 587, including the supervisory officers and the monthly output consists of 20 general repairs, including an average of three fireboxes per month.

Swivel Chuck for Rod Brasses

A SWIVEL chuck for holding rod brasses that are bolted to the bed of a shaper or planer is shown in the sketch. It is so designed that a brass may be machined on all four sides and at any desired angle.

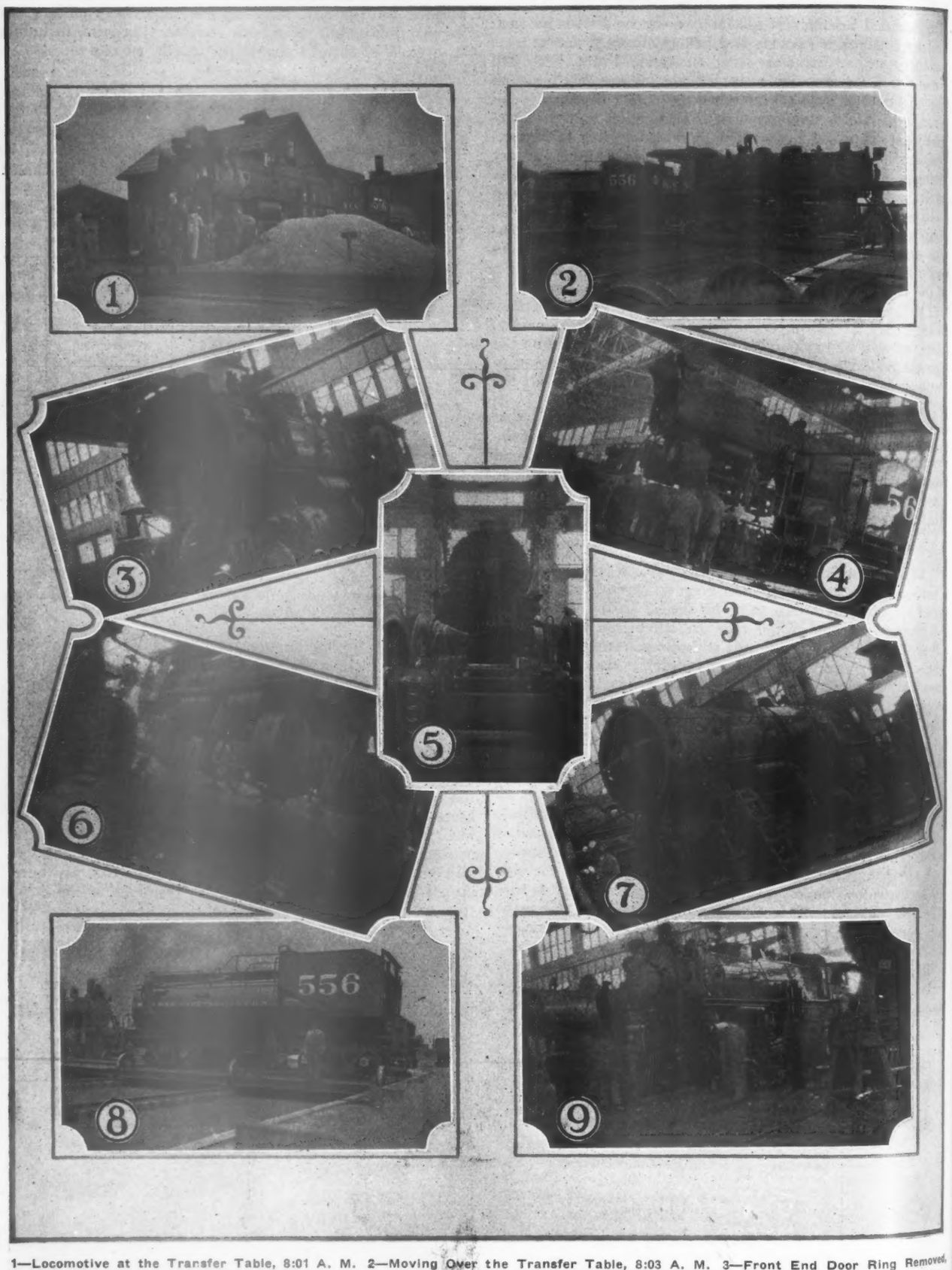
The chuck consists of a clamp and bracket with a base



This Device Holds a Rod Brass So That It Can Be Machined on All Four Sides at One Setting

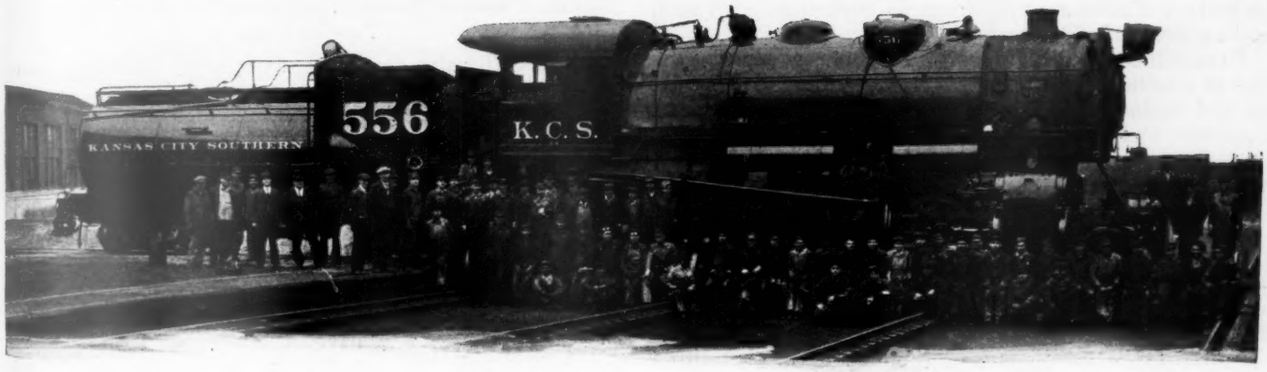
11 in. by 20 in. and a face 16½ in. high. It is fastened to the bed of the machine by four bolts. The brass is secured to the face of the chuck by means of a clamp that is provided with two jaws, as shown at *A*. This clamp is held to the face by a 1½-in. bolt with head 4 in. square and ⅞ in. thick. The stationary jaw is provided with four ¾-in. holes that correspond in position to similar holes in the face. The pins *B* are inserted in these holes to prevent the clamp from turning. When it is desired to turn the brass, it is only necessary to pull the pins and loosen the nut *C*. The clamps *A* do not need to be touched until the entire job is finished. This feature permits uniformity on all four sides and no further adjustment for accuracy is required after the brass and chuck has been once set up.

Interior View of the Erecting Shop at Billerica, Mass., on the Boston and Maine



1—Locomotive at the Transfer Table, 8:01 A. M. 2—Moving Over the Transfer Table, 8:03 A. M. 3—Front End Door Ring Removed, 8:26 A. M. 4—The Locomotive Unwheeled, 8:52 A. M. 5—Part of the Tubes Removed; Duplicate Drivers and Boxes in the Foreground, 10:10 A. M. 6—Starting to Wheel the Engine, 10:32 A. M. 7—Condition of the Engine at Noon, 12:02 P. M. 8—Tender on the Transfer Table, 3:30 P. M. 9—Applying the Front End Door Ring, 4:18 P. M.

K. C. S. Makes Class 3 Repairs Within Eight Hours

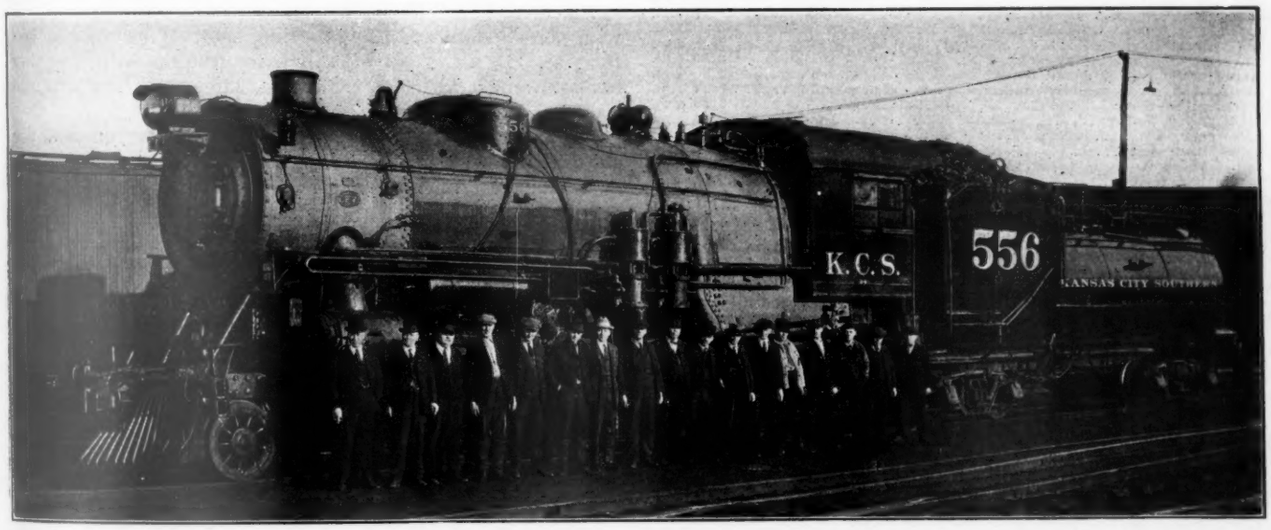


Shows Possibilities of Modern Facilities, Co-operation and Separation of Repairs and Erecting

TIME records for making Class 3 locomotive repairs on the Kansas City Southern were broken on March 17, 1924, when locomotive No. 556 was given Class 3 repairs in the shops at Pittsburg, Kans., in 7 hrs. 55 min. Locomotive No. 556 is a heavy 2-8-0 type, coal-burning engine used in freight service and known as Class E-4. The locomotives of this class were built in 1913 and have the following principal weights and dimensions:

Weight of locomotive, loaded	254,000 lb.
Weight on drivers, loaded	224,000 lb.
Weight on tender, loaded	172,200 lb.
Wheel base, engine	26 ft. 10 in.
Wheel base, engine and tender	66 ft. 9 in.
Cylinders, diameter and stroke	26 in. by 30 in.
Diameter of driving wheels	57 in.
Tractive force	55,948 lb.
Boiler pressure	185 lb.
Boiler, inside diameter, first course	82 in.
Firebox, length and width, inside	108⅛ in. by 83¼ in.
Tubes, number and diameter	219—2¼ in.
Flues, number and diameter	38—5½ in.
Length over tube sheets	15 ft. 6 in.
Valve gear	Walschaert
Piston valves	14 in.
Tender capacity, water	9,000 gal.
Tender capacity, coal	17 tons

Shop facilities at the division and shopping points have been greatly augmented in recent years. Especially is this true at Pittsburg where extensive additions have been made in the way of buildings and machinery. To test the resources of the Pittsburg shop and to better the records of similar projects recently carried out by the Southern Pacific and Delaware & Hudson, the management decided to make Class 3 repairs on a heavy locomotive in eight hours or in a shorter time if possible.



Officers and Supervisors Responsible for Giving This Locomotive Class Repairs in 7 Hr. 55 Min.—M. A. Hall, Superintendent of Machinery, at the Left

On January 7, the general plans were formulated by M. A. Hall, superintendent of machinery, in conference with J. W. Chandler, master mechanic; R. Skidmore, shop superintendent; William Nelson, mechanical engineer, and C. Y. Thomas, supervisor of apprentices. Three weeks previous to shopping the engine, Mr. Hall, through the foremen and the shop council, completed the program of procedure, and the foremen were informed of their specific duties so as to reduce the confusion incidental to a performance of this kind.

Class 3 repairs includes parts of firebox sheets renewed, or firebox patched; an entire set of new driving wheel tires, or an entire set of driving wheel tires returned; an entire set

of new boiler tubes applied, or an entire set of boiler tubes repieced and reset; all driving wheels removed and general renewals and repairs to the boiler, firebox, cylinders, steam pipes and chests, frames, running and motion gear, bearings, air brake and other special equipment, trimmings, draft gear, tenders, etc., and repainting.

To expedite this work a number of duplicate engine parts were in readiness previous to March 17, such as retired driving and engine truck wheels, driving boxes with new bearings, side and main rods with bushings, crossheads and pistons, link work (except trunnion bushings), brake rigging, etc.

How the Work Was Done

The locomotive was moved into the shop at 8.05 a.m. After stripping, the engine was picked up by the 250-ton crane and carried to another pit where the various repairs proceeded, such as welding a broken deck casting, rolling in 219 tubes and 3 flues, changing the air cooling pipes from near the firebox to the front part of the engine, applying main and side rods, etc. In addition to the above mentioned work, two new piston heads were applied and new cylinder packing fitted, one piston rod was turned and one new piston rod applied, four new crosshead gibs were applied, two new crosshead pins turned, eight new valve rings were cut and spotted and eight new shoes and eight new wedges machined and fitted.

The progress of the work on the locomotive while in the shop is shown in the following tabulation:

Engine awaiting movement into shop	8:00 a.m.
Engine moved on transfer table	8:03 a.m.
Engine moved into shop	8:05 a.m.
Cylinder heads and piston valve heads removed	8:15 a.m.
Dome cap removed	8:16 a.m.
Tender detached	8:17 a.m.
Headlight removed	8:20 a.m.
Main rods taken down	8:25 a.m.
Front end door ring removed	8:26 a.m.
Driving brake rigging taken down	8:30 a.m.
Pistons taken out of cylinders and crossheads taken down	8:31 a.m.
Binders taken down	8:40 a.m.
Piston valves pulled	8:45 a.m.
Links removed	8:46 a.m.
Engine unwheeled	8:52 a.m.
Engine swung in crane ready to move to adjoining pit	8:57 a.m.
Throttle box removed	9:00 a.m.
Engine moved to other pit	9:05 a.m.
Nozzle stand removed	9:15 a.m.
Crossheads put on	9:30 a.m.
Flues, removal started	9:31 a.m.
Tender trucks removed	9:32 a.m.
Pistons put in cylinders	9:50 a.m.
Wheeling, started at	10:32 a.m.
Tubes removed	10:45 a.m.
Driving and engine truck wheels under engine	11:00 a.m.
Tube setting started	11:05 a.m.
Air pumps applied	11:45 a.m.
Links hung	11:46 a.m.
Trucks placed under tender	11:47 a.m.
All binders put up in place	2:00 p.m.
Engine trammed and changes made in shoes and wedges	3:00 p.m.
Boiler tested	3:30 p.m.
Main and side rods applied	3:35 p.m.
Nozzle stand applied	3:45 p.m.
Valve motion set up	4:00 p.m.
Cooling pipes applied	4:05 p.m.
Throttle box and dome cap applied	4:15 p.m.
Front end door ring applied	4:18 p.m.
Front end closed	4:30 p.m.
Valve setting completed	4:45 p.m.
Engine pulled out of shop	4:50 p.m.
Tender connected	4:55 p.m.

The engine was broken in very satisfactorily the following day, March 18, and went into regular service at 3.55 a. m., March 19, when it departed from Pittsburg for Kansas City, hauling a full tonnage train.

There have been no hot boxes on the engine or tender, nor hot side or main rod bearings and no failures due to steaming have been reported.

With the unreserved co-operation of the mechanics, apprentices, helpers and laborers, who bent all efforts towards the completion of the project, the work progressed smoothly and was completed without serious difficulty. Everyone concerned had deep interest in the work and this interest and loyalty has caused the management to look towards a future proposition of making Class 1 repairs on a Consolidation or Pacific type locomotive in six days.

Valve and Valve Gear Repairs*

By J. H. Armstrong

Assistant General Foreman, Atchison, Topeka & Santa Fe, Topeka, Kans.

AFTER all valve gear parts are removed from the engine at Topeka shops, they are placed in a crate, sent to the lye vat and thoroughly cleaned, then being delivered to the motion gang where all parts of the valve gear, side and main rods, crossheads and guides are repaired.

The foreman in charge and a mechanic inspect all parts for defects and worn places, and all parts are checked up for proper blue print lengths. If any parts are found to be incorrect, we send them to the blacksmith shop and they are altered in accordance with the blue prints.

Worn places on the valve gear parts are electric welded and faced with a jig we have for that purpose which makes the faces square with the pin holes. We then rosebit all holes, fit new brass bushings and straight ream the brass bushings to the standard sizes for the pins.

If we find any of the flaws with too much lateral, we close the jaws to suit. All new motion pins are turned, drilled for dowels, threaded and sent to the blacksmith shop for case hardening. The links also are hardened, after which they are ground to a templet with the proper radius. Link blocks are ground on the radius face and pin holes.

Eccentric cranks and blades, eccentrics and straps are repaired in a similar manner. All main axles on Stephenson valve gears are laid out to a templet and all eccentrics keyed on before wheeling in the engine. If new axles are applied, the keyways are milled for the eccentrics with a milling machine.

All valve bushings are inspected to see if they are round, with ports spaced according to blue print. They are checked for size. If found out of round, we true up with a boring bar and renew when worn 3/16 in. larger than the original size.

All valve chamber bushings which must be renewed are chipped out with air hammers, our experience showing this to be the best method so far developed. Before applying new valve bushings we caliper all the valve chamber ribs to see if they are round and of the same size. If they are not we bore the valve chambers before the bushings are fitted. All valve chamber and cylinder bushings are pulled in the cylinder with a hydraulic bushing inserter, the time required being about 30 minutes a bushing.

The gang foreman on the erecting floor applies all rocker boxes, tumbling shafts, links, valve gear parts and valves, also power reverse gears or reverse levers and quadrants. Valves are set by one mechanic, one apprentice and a helper. We have an air-driven machine to roll the wheels in the forward or back motions in order to square and set all valves to the prints on different class engines.

If we find an engine carrying ¼ in. lead and 5 in. valve travel and the print calls for 3/16 in. lead and 5¾ in. valve travel, we make the proper changes to set the valve according to blue print instructions.

Piston valves are stripped complete and each part stencilled. The stems are calipered for the scrapping limit. The bullrings, spiders and bodies are sent to the sand blast to have the carbon removed. After returning from the sand blast, the bodies are calipered for length and also to see if they are parallel. If not, they are welded and faced square and for length on the boring mill. The spiders are sent to a lathe and the ring seats faced square. The valve stems are trued, threads on the end rechased and dowel pins and cotter key holes redrilled. The valve stem keys are fitted to the crossheads or valve rods.

As soon as the valve bushings are bored, they are calipered

*From a paper presented before the 1923 convention of the International Railway General Foremen's Association.

and the bullrings are turned to fit the bushings, old bullrings being used wherever possible. After the bullrings are turned, the rings are fitted to the cylinder. One ring is fitted to each bushing and the remainder are fitted to a bushing tub at the bench. After the rings are fitted to the cylinder, the valve is assembled.

The rings are fitted to grooves in the bullring to see if they have the proper amount of lateral. Then the small bullring keys are fitted to the spider and the bullring. The spider rings and bullrings of the front end of the valve are laid on two small blocks on the floor and the body is placed on top. The same process is followed for the back spider bullring and rings as previously stated and then they are placed on top of the body. The stem is dropped through the spiders and body and driven in place with a light sledge. A castle nut is screwed on the end of the stem and the valve is then laid on the floor and the nut tightened with a wrench.

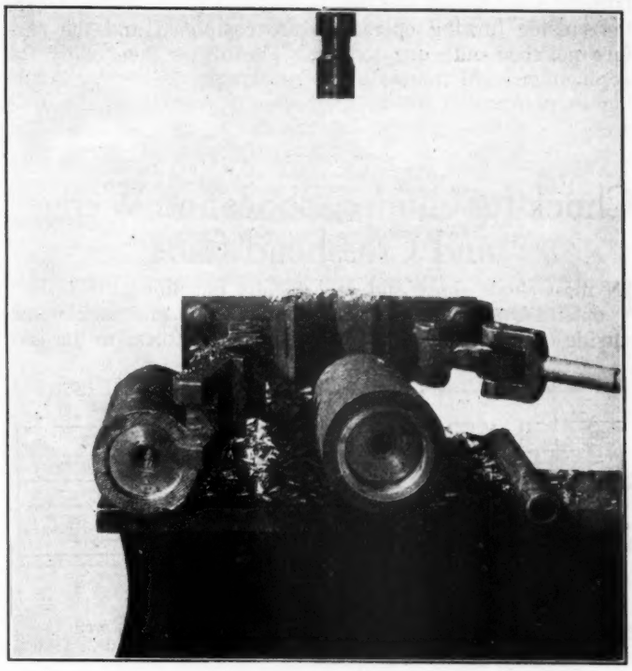
The valve is checked for length inside and outside of the rings, for admission and exhaust opening, lateral of rings and for squareness of the valve. If found correct it is ready to be applied to the valve chamber.

Saving Operations in Finishing Crank Pins

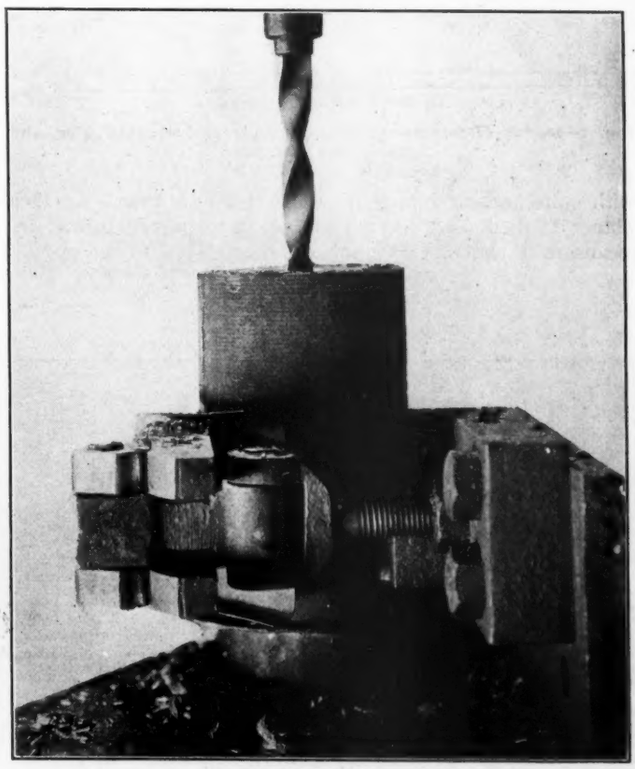
A METHOD of machining crank pins, described in the April issue of the Norfolk & Western Magazine, has been developed by U. V. Garred, efficiency engineer, and F. H. Wicks, gang leader in the machine shop, which requires but one setting of the pins on the drill press and one setting in the lathe, and by which has been effected a saving of 35 min. in the time required for completely finishing a crank pin.

The Use of the Counterboring Tool Shown Here, Is Followed by the Tapping Operation

Before this method was developed, the pin was first set up in the drill press and the hole drilled in the center for the collar bolt. The pin was then set up in a lathe and the outside turned to size and polished. A steady rest was then used to support the pin while the counterbore for the collar was finished, after which the bolt hole was tapped out. In many instances it was found that the steady rest had scored the surface of the pin so that repolishing was necessary.



The Chuck Open, Ready to Receive the Crank Pin



Special Drill Press Chuck for Holding Crank Pins While Drilling and Counterboring for the Collar Fit

By the use of a special chuck on the drill press the pin is now quickly set up for the drilling operation. When this

is completed, a special counterboring tool is placed in the drill spindle and the collar recess refinished in one operation. The tap is then placed in the drill spindle and the bolt hole tapped, after which the pin is removed to the lathe, where the outside turning operations are completed and the surface polished with one setting. The pin is then ready for application. No trouble has been experienced from chattering in performing the counterboring operation on the drill press.

Chuck for Guides, Shoes and Wedges and Crosshead Gibs

IN most shops shoes and wedges are machined inside and outside by two planers. One planer is used to machine the outside of the shoe and wedge by clamping them to the bed

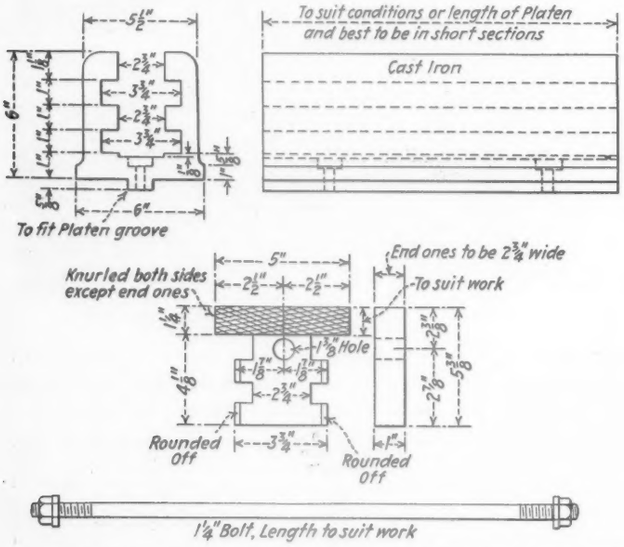

To suit conditions or length of Platen and best to be in short sections
Cast Iron
To fit Platen groove
Knurled both sides except end ones
End ones to be 2¾" wide
To suit work
1⅜" Hole
Rounded Off
Rounded Off
1¼" Bolt, Length to suit work

Fig. 1—Sketch of Improved Chuck for Guides, Crosshead Gibs, and Shoes and Wedges

with bolts and machining only one side at a time. Another planer is then used for machining them on the inside, by means of a chuck. This makes it necessary to set up the shoes and wedges three different times before the job is completed.

Either of the two chucks shown in the sketches will hold an entire planer platen full of shoes and wedges so that they may be machined complete inside and outside in one setting. By using both heads and double tool posts on each head, a set of shoes and wedges can be machined as quickly

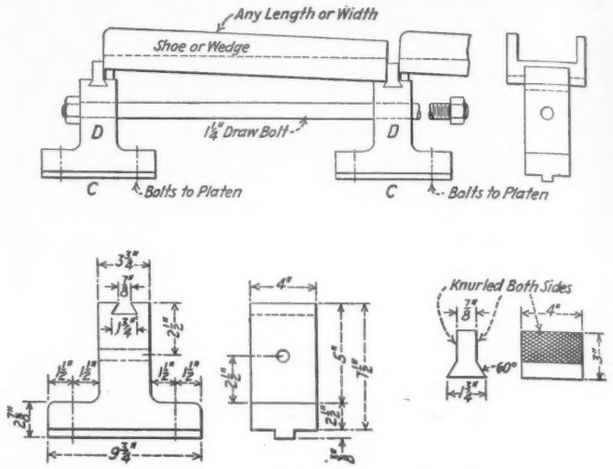
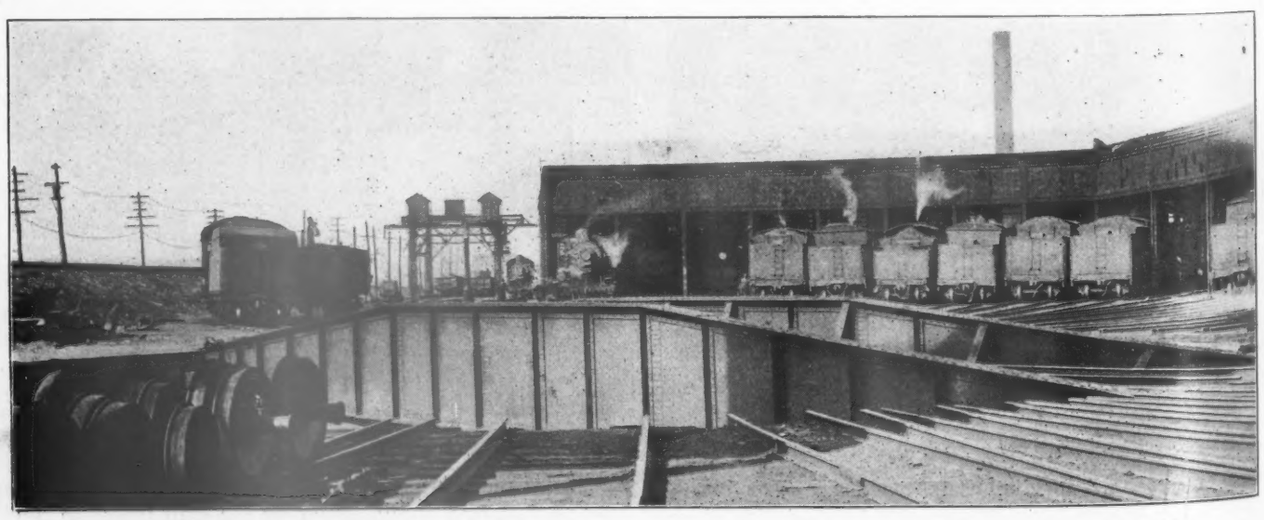


Fig. 2—This Chuck is Simple in Construction and Can Be Easily Adjusted

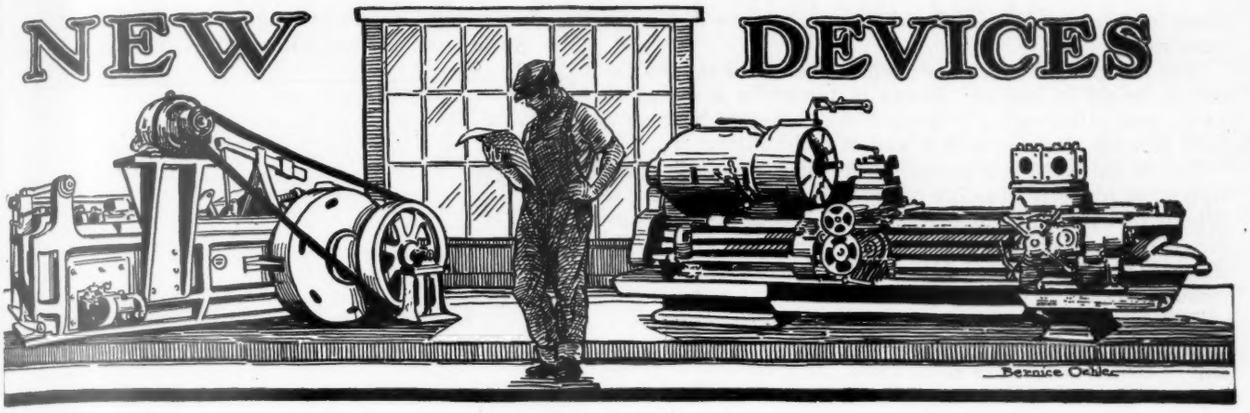
as a set can be machined on the outside by the common method.

The chuck, Fig 1, consists of a cast iron base provided with annular grooves, which is bolted to the platens. A guide or crosshead gib is clamped in position by a jaw equipped with lugs, as shown in the sketch, which fit into the grooves of the base. A 1¼-in. bolt, threaded at both ends and made sufficiently long to hold an entire row, is used to tighten the jaws against the work.

Both chucks hold the work in a similar manner but the chuck shown in Fig. 1 is somewhat handier for an operator because the bolts *C*, used on the chuck shown in Fig. 2, must be loosened at each setting in order to have the standards *D* set along the platen to suit the length of the work. Either of these chucks is an improvement over the old method and they will hold any job, such as guides, shoes and wedges, crosshead gibs and similar work, in a satisfactory manner.



Modern Rectangular Type Enginehouse of the New York, New Haven & Hartford at Boston (Southampton Street), Mass.



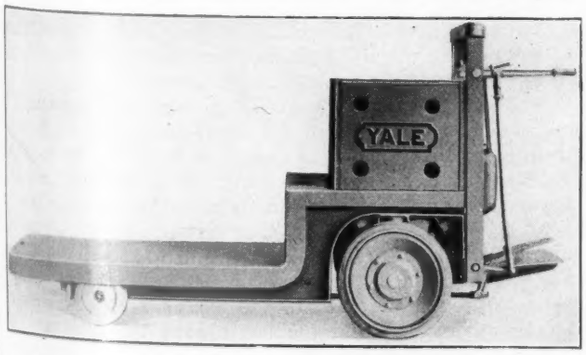
A Complete Series of Industrial Trucks

THE Yale & Towne Manufacturing Company, Stamford, Conn., is manufacturing five new types of industrial trucks, known as the K-20 to K-24, inclusive. This set constitutes a complete series of trucks, each of which is designed to fill a definite place in the scheme of material handling around a railroad shop.

The K-20 model is designed to meet the general require-

Model, K-20, High Platform General Utility Truck

ments of intraplant movement. It will handle miscellaneous units of material which may be placed on the platform by hand, hoist, or overhead crane service. The auxiliary equip-

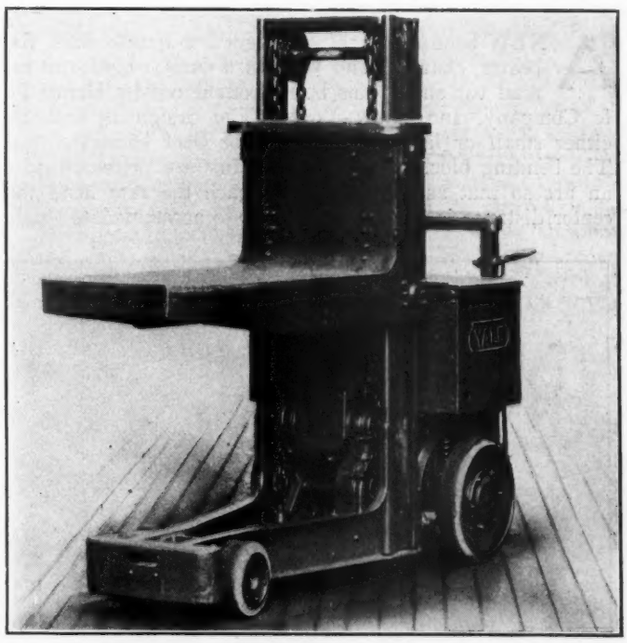


K-23 Is a General Utility Truck Built for Heavy Duty

ment designed for it includes a gravity dump body for handling loose material and an electrically operated swinging boom crane. It has large wheels and full spring suspension which permits of operation over rough surfaces. The controlling mechanism is especially constructed to facilitate handling in narrow aisles and congested places. All parts are easily accessible and are grouped in self-contained major units. The truck has a rated carrying capacity of 4,000 lb. and can be turned in a radius of 91 in. The wheel base is 58 in. and the overall length is 102¼ in., with an overall width of 84 in.

The model K-21 truck is similar in form to the K-20, but is equipped with a wider platform.

Model K-22 is a self-loading transportation unit in which



The Elevating Platform Truck, Model K-22, Is a Self-Loading Transportation Unit

are combined the advantages of high and low lifting. It may be used to lift loaded skids from the floor, transport them to a given place and raise them to a higher level in order to facilitate stacking or tiering in a storeroom or freight car. This model has a low center of gravity and the longitudinal frame members are made of pressed steel, which permits it to carry a 4,000-lb. load. The lifting and lowering mechanism is of the triple, spur-geared reduction type, electrically driven. It is equipped for electric braking and has a mechanical aux-

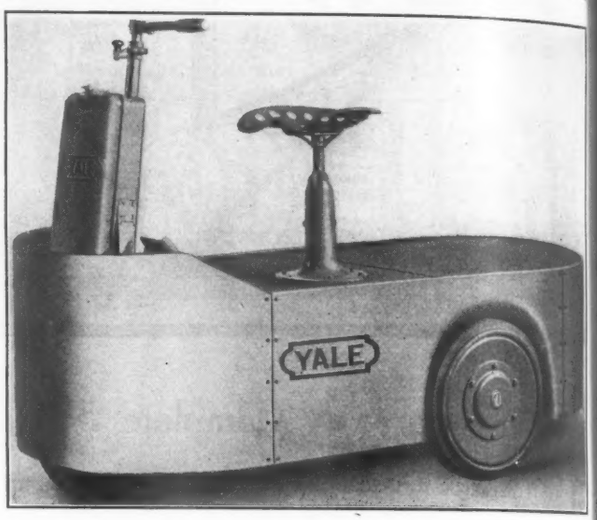
iliary lowering-speed control with automatic upper and lower limit stops.

The Model K-22 truck has a wheel base of 55 in. and the overall height is 105 in. It can be turned in a radius of 84 in. and will travel at a speed of 6¼ miles an hour on a level concrete roadway, with a load of 4,000 lb.

The Model K-23 is a general utility truck and is designed with a low platform to reduce heavy lifting to a minimum. It is built for heavy duty and for operation where the road surface is in average good condition. Its overall length is 110¼ in. with a wheel base of 55¼ in. and can be turned in a radius of 89 in.

This company has also placed on the market a three-wheel truck known as K-24. Its platform area of 15 ft. is 70 per cent of that of the Model K-20 truck. It is capable of passing through a 3-ft. doorway, and may be carried on a 7-ft. elevator. This machine has a low center of gravity which is designed to prevent bucking, overturning against stalling loads, or tipping over sidewise while rounding a corner. The frame is made of heavy pressed steel and contains the battery compartment, bumpers and deck, which makes a solid and rugged one-piece structure. It is suspended on helical springs over each wheel. The seat is further protected by an additional spring of the swivel type, which enables the operator to get on or off the machine with greater facility and to look or reach back to the coupling point. The clear deck gives him unobstructed vision of the drawbar, which is essential for safe fast operation.

With the exception of the Model K-24, the various parts of these trucks are interchangeable with each other. The five trucks are equipped with spur-geared unit power axles,

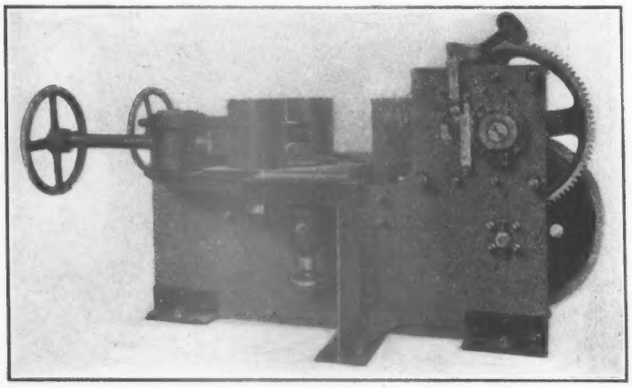


Model K-24 Is a Combined Tractor and Truck for Operation in Congested Spaces

which are identical and interchangeable with all of the trucks of the K series. Heat-treated alloy steel and ball bearings are used throughout.

A Horizontal Eccentric Bending and Straightening Machine

A NEW bending machine designed to handle bars, flats, beams, channels and work of a similar nature in railroad car shops, has been brought out by Henry Pels & Company, Inc., New York. The design is such that either small or large sections can be bent or straightened. The bending blocks may be moved forward or backward on an arc so that as the blocks approach the ram head their center distance is shortened in order to accommodate smaller



Machine for Bending or Straightening Heavy Channels

sections and shorter radius curves. As the blocks recede from the ram head, their center distance is increased to accommodate larger sections and longer radius curves.

With this arrangement it is unnecessary to make a special adjustment of the bending blocks to suit the size of each section to be bent. The arc lines of travel of the bending blocks have been determined from the moment of resistance of various sections as well as from results of actual tests. It has been found that for practical reasons a beam cannot be bent with blocks as close together as would theoretically be permissible, and that the conditions are also materially different when bending the same beams flatwise and edgewise. It has also been found that in determining whether a beam can be bent on a machine, it is not so much the weight of the section that should be considered as its shape moment of resistance. For bending rails or similar heavy sections, it is recommended that blocks be used between the ram head and the section itself.

The construction of this bending machine embodies the same features as the other lines of punching and shearing machinery manufactured by this company. It is constructed with heavy steel plate frames of special analysis and high tensile strength and the design provides a high factor of safety. The gears are made of steel with machine cut teeth; all pinions and shafts are forgings. The bearings are of liberal dimensions and are provided with phosphor-bronze bushings. The main shaft bearings are equipped with ring oilers.

The table is especially wide and substantial to insure ease of handling. In addition, it has a horizontal roll on each side to facilitate pushing the bars across the table.

The bending blocks can be adjusted independently of each other by means of a hand wheel and screw which moves them in the arc groove, as shown in the illustration. When a beam is placed in the machine, the blocks are adjusted toward the ram head until the head, in its travel, starts the bending. The blocks are then given further adjustment until the desired curve is obtained and when this adjustment has been completed, the length of section to be bent can then be fed through the machine as far as necessary. As the blocks advance around the arc toward the ram head, the center distance between them decreases. Thus any danger of overloading the machine is eliminated as the beam has lost part of its resistance against bending as soon as the first slight bend has been made. These machines are said to be rapid in operation and to have small power consumption. The space required is comparatively small.

Washburn Side Frame for Arch Bar Trucks

THE Baltimore & Ohio is using something over 40,000 arch bar truck frames of a unique design. The first of these frames were applied to the new equipment ordered in 1922, and they are now in service on box and gondola cars of 80,000 lb., 110,000 lb. and 140,000 lb. capacity. The side frames of the trucks referred to were designed by Edwin C. Washburn, assistant to the president of the Baltimore & Ohio.

The object aimed at in this design is to use as large a quantity of rolled material as possible and to take advantage of the merits of the arch bar type while eliminating its undesirable features. Rolled bars are low in cost and are of definitely known strength. But inasmuch as nearly a third of the arch bar material in the old M.C.B. design was removed to allow the introduction of the column bolts and, furthermore, as these holes were drilled near the bends of the bars, the frame was not as strong as the weight of material would warrant. In the Washburn design these points of weakness have been corrected.

A drawing and a photograph of 55-ton B. & O. truck frame, as manufactured by the Standard Steel Car Company, Butler, Pa., are shown in Fig. 1 and Fig. 2. The other two sizes are similar in construction, although differing in dimensions. In the 70-ton truck frame two 1⅛-in. pins are used on either side to connect the upper arch bar to the center casting.

A modified design is shown in Fig. 3. In this form the head castings are omitted and the ends of the arch bars are of the regular M.C.B. design and take the regular journal box and bolts. A third design is shown in Fig. 4. In this case the journal box and head casting are integral, the box being attached by a pin and cast steel filler at the top, the same as in Fig. 1. In both of these designs the center casting is riveted to the lower arch tie bars by means of 1-in. rivets, but as these rivet holes are some distance from the easy bend, the bars are not unduly weakened.

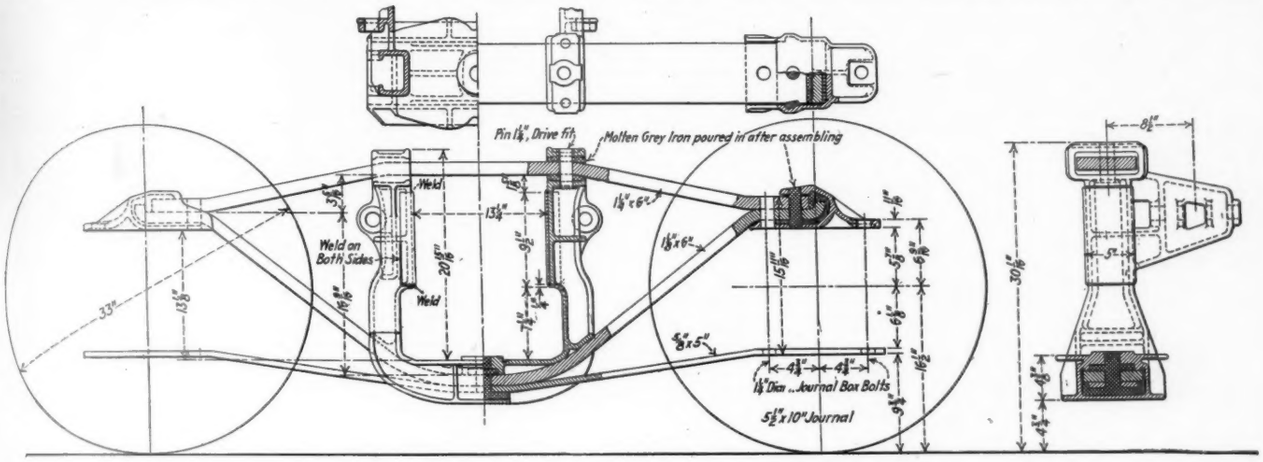


Fig. 1—55-Ton Washburn Truck Used on the Baltimore & Ohio

The Washburn side frames have the usual top and lower arch bars and a tie bar. The lower, or tension member has its end turned up and the upper bar is carried to this projection. To assemble the frame the bars are first passed through the center column casting, and the two recessed head castings, shown in Fig. 1, which fit over the journal boxes, or the special journal boxes shown in Fig. 4 are slipped over the ends of the arch bars. Rolled steel pins are driven through the arch bars and the heads of the columns and usually also through the bars and head castings. The as-

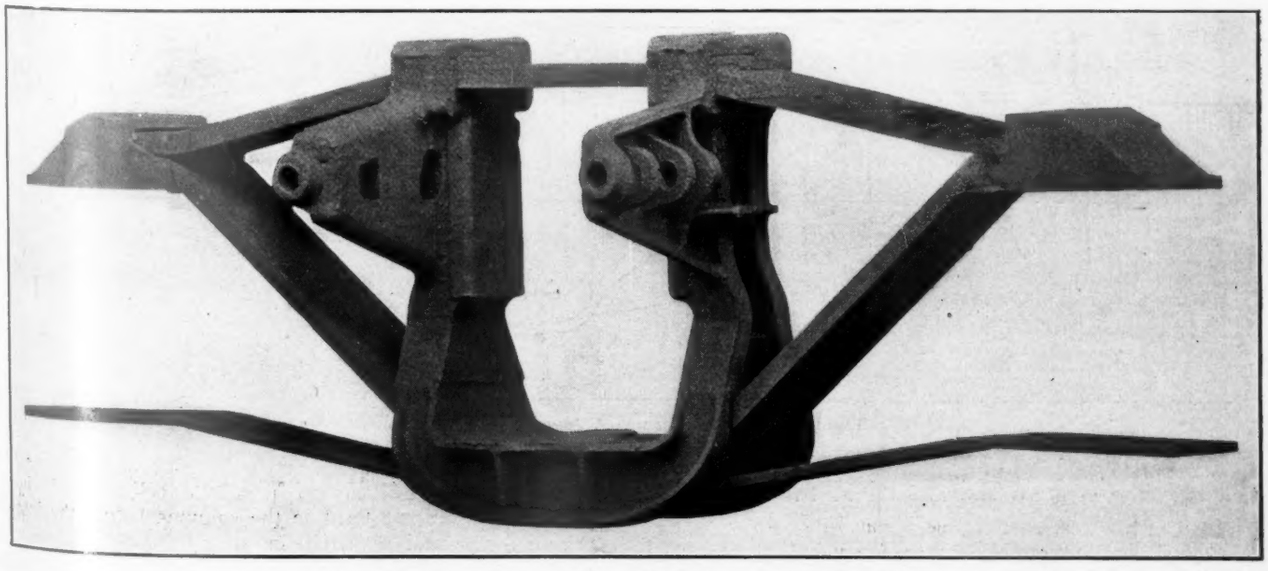


Fig. 2—Washburn Side Frame for Baltimore & Ohio 55-Ton Cars

sembling of the frames is done on jigs, thereby assuring accurate measurements and uniform wheel centers. Chills, or other material are used to stop up the openings, and cast steel or other suitable material is then poured into the upper openings in the center column casting and in the recessed end castings. In most of the trucks cast metal has also been used to unite the center column and the lower bars. This gives a solid integral construction. It is not necessary that the filler material be fused to the bars as it forms simply a compression filler block which is cast in to hold the parts in position. Referring to the illustrations, it will be observed that the lower arch bar and also the tie bar are free from sharp bends. Where they pass under and leave the center column casting, the curves are of particularly large radius and the bars are not weakened by rivet holes. The construction is thus more reliable than the old M.C.B. design.

In the event of breakage of a head casting or an integral journal box, the defective part may be burned off and a new piece substituted, a new pin being driven in and the retaining metal poured into the cavities.

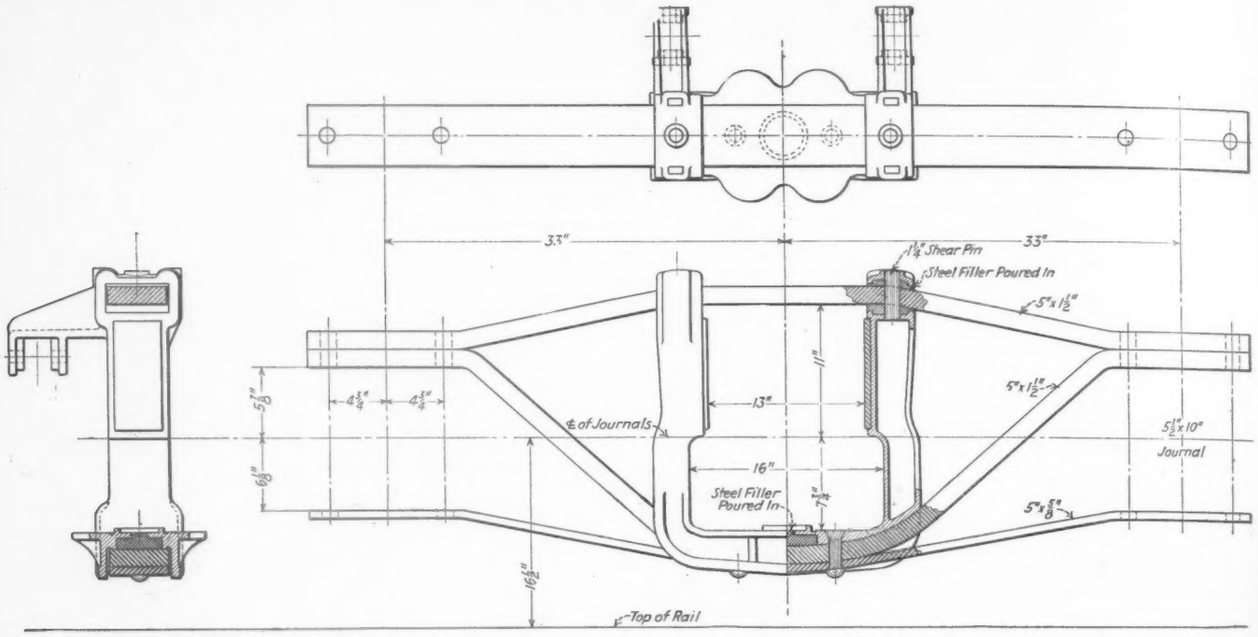


Fig. 3—Washburn Truck Side Frame with M. C. B. Arch Bar Ends for 55-Ton Cars

These truck frames have shown very satisfactory results on the road as well as under drop and static tests, and when tested to destruction do not break, but bend. Should they become distorted by a wreck or derailment, they would still have sufficient strength to carry a load to the terminal.

A few of the earlier frames made did not have the bars pinned to the column heads and as a result continued usage or wrecks had a tendency to spread the columns. As now made, the bars are pinned to the columns before the interlocking filler metal is poured in.

The sale of these frames is now being handled by the Duquesne Railway Supply Company, Pittsburgh, Pa.

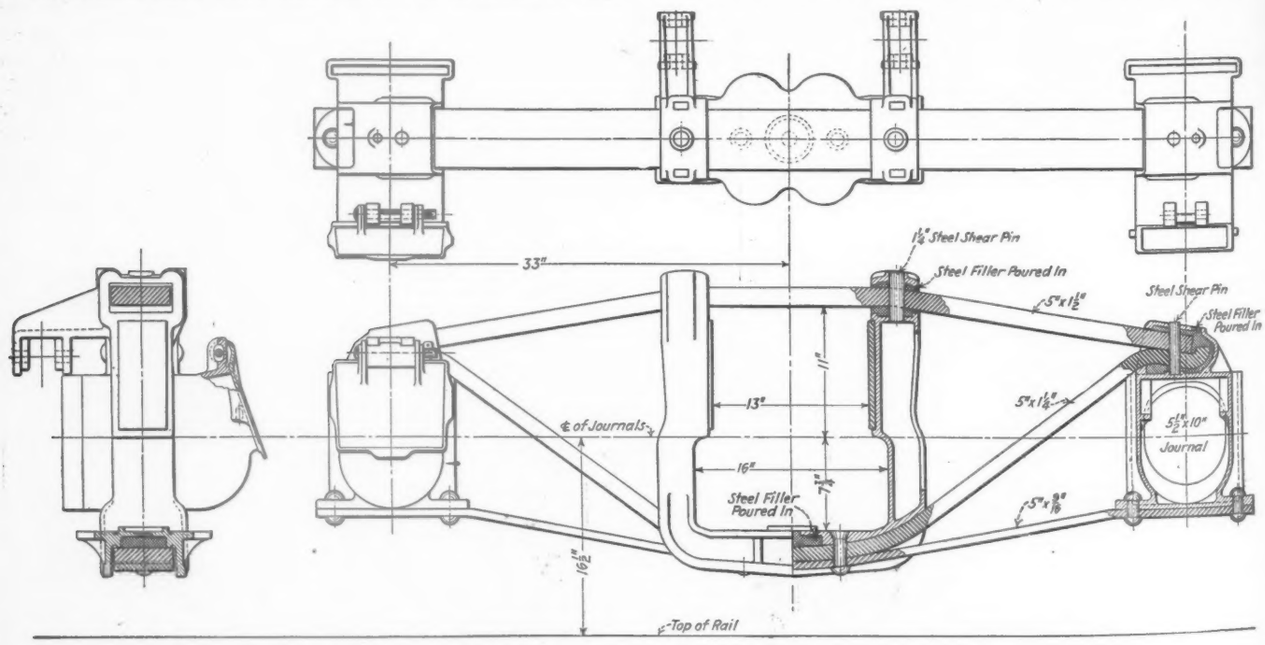


Fig. 4—Washburn Truck Side Frame of Journal Box Type for 55-Ton Cars

A Pneumatic Flange Oiler for Locomotives

A PNEUMATIC flange oiler for lubricating locomotive and wheel flanges has been developed by the Hoofer Manufacturing Company, Chicago, and is shown in Fig. 1, applied to an Indiana Harbor Belt locomotive. By means of this device measured amounts of oil are fed to the wearing surfaces of the flanges by air pressure, at regular distance intervals. The oil is not sprayed on the flanges, but is gradually released from the oil shoes by an extremely small amount of air, vented through the oil pipes. This air acts as a preventive against stoppage in the oil shoes and

Fig. 1—Indiana Harbor Belt Locomotive Equipped with the Hoofer Flange Oiler

is designed to assume positive delivery of oil to the wheel flanges at the proper intervals.

Air pressure for the operation of the oiler is obtained through a pipe from the cab of the locomotive, where the air is comparatively free from condensation. A ratchet-type air control valve is installed in this line at a point where its control lever may be connected to receive a reciprocating motion from the radius bar or valve stem of the locomotive. The control valve is so designed that it opens and closes the air pressure supply to the lubricator once in every 100 revolutions of the driving wheels, and at these intervals the air pressure forces the discharge pistons downward into their respective oil cylinders at the bottom of the lubricator, causing a measured amount of oil to flow from the lubricator. At the same time a vent of air flows through the discharge pistons and carries oil through the oil pipes and the oil shoes to the flanges. When the air pressure is again cut off by the air control valve, the piston springs, convoluted about the discharge pistons, return them to their initial positions preparatory to their next lubricating operation. The amount of oil discharged at each interval may be regulated for each wheel separately. The oil cylinders, located at the bottom of the lubricator, are provided in various depths and are interchangeable so that one of the proper capacity may be substituted for another when required.

This lubricating system does not depend on any care or attention on the part of the engine crew. There are no valves to be manipulated either before or after the trip. The device is designed to be fool-proof. It functions only when the locomotive is in service, and stops when the locomotive is at rest. The pneumatic venting feature provides a circulation of warm air through the oil pipes and oil shoes which tends to raise the temperature of the oil and to allow the device to be used successfully in cold weather as well as in summer.

Proper distribution of oil is essential to successful flange lubrication, and the oil shoes shown in Fig. 2 have been especially designed for this purpose. The outlet passage for the oil is constantly maintained in contact with the side of the flange which wears against the rail, and thus the oil is supplied in a thin film on the part of the flange where it is most needed. The cast oil shoes, made of a special grade of white iron, are said to wear from 50,000 to 75,000 miles without renewal. The oil shoes are secured to their hangers by a tapered key, which may be easily removed when it becomes necessary to renew them. Hanger springs are designed to hold the shoes against the wheel flanges in a well balanced position at all times.

An important feature developed in the oil shoe rigging

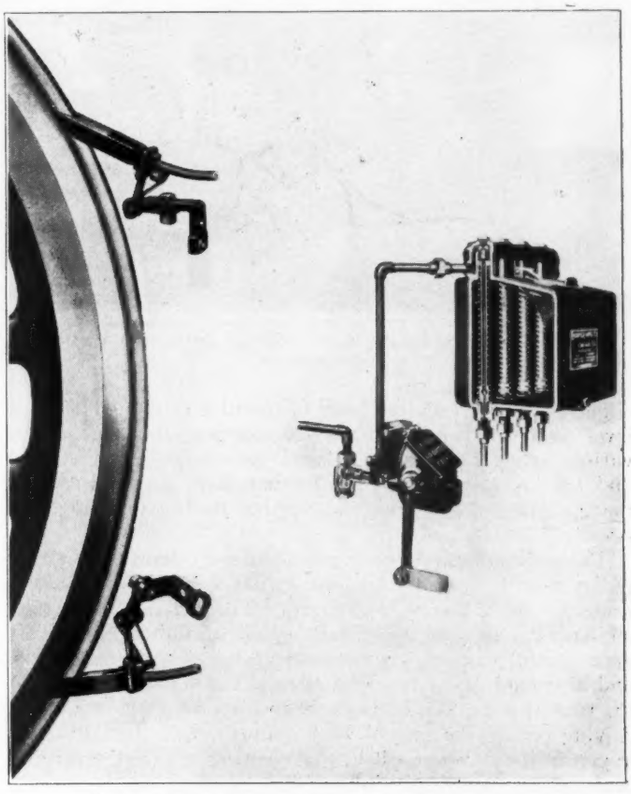


Fig. 2—Oil Shoes May Be Applied in Either of the Positions Indicated; A Section Through the Lubricator

permits of applying the shoes to the wheel flanges in either an incline or decline position as shown in Fig. 2. The pneumatic venting method of feeding the oil through the oil shoes is said to convey oil successfully to the flanges in either position of the shoe. The parts comprising the oil shoe rigging are designed so that they may be assembled in various combinations to accommodate the various ways in which they are required to be attached to the frames of locomotives of various types, or to car trucks and electric power.

The Hoofer pneumatic flange oiler has been applied successfully to locomotives operating under severe conditions of

flange wear, such as a long rigid wheel base and sharp road curves. Fig. 1 shows one of these lubricators applied to an Indiana Harbor Belt locomotive, 50 of which are equipped with this device. A test installation was also made on 20 locomotives of the Chicago Junction Railroad which has now adopted the Hoofer oiler as standard for all locomotives.

Universal Grinding Machine with Constant Speed Drive

A UNIVERSAL grinding machine of the constant speed drive type, known as the No. 2-1, is being manufactured by the Brown & Sharpe Manufacturing Company, Providence, R. I. It possesses all the advantages of a constant speed, self-contained drive and has a number of productive features built into its design, such as an independent automatic cross feed, quick traverse of the wheel slide, and an all-geared change speed and feed mechanism, which is a new feature of this line of machines.

The table and work is controlled by the hand lever shown

Rear View Showing the Self-contained Drive and Belting Arrangement

slightly to the left of the center of the illustration. The same lever also actuates the brake for stopping the table. The various other controls are placed conveniently at the right and left of the operator that he may have entire control of the operation of the machine without having to change his position.

The constant speed, self-contained drive consists of a single pulley 8½ in. in diameter that carries a 4½-in. belt and is protected by a heavy belt guard. The driving shaft runs on ball bearings at a constant speed of 900 r.p.m. This arrangement dispenses with considerable shafting and belts, and also renders the machine adaptable for motor drive. At the rear of the machine on the main driving shaft is a wheel driving pulley, the face of which is made exceptionally wide to permit the travel of a belt, that compensates for the varying position of the wheel slide. The grinding wheel spindle is driven from this pulley by a belt running over horizontal idlers, mounted on roller bearings carried in a swinging frame, and vertical idlers mounted on the wheel stand. The swinging frame automatically provides for keeping an even tension on the belt, regardless of the position of the wheel spindle. An adjustment is also provided to take care of the stretch of the belt and split pulleys of different diameters used to obtain the various wheel speeds.

Contained within the base is an oil pump and tank which furnishes a constant supply of lubricant by means of pipes running directly to the various mechanisms. This system subjects the operating mechanisms to a constant deluge of oil, which, after passing over the various bearings, is returned to the tank. Bearings that are not automatically lubricated are provided with sight feed oilers or grease cups. The oil is automatically shut off when the table operating mechanism is stopped.

The wheel spindle is made of alloy steel. It runs in bearings that are hardened, ground and lapped, with self-alining bronze boxes provided with a means of compensation for wear. It takes a wheel with a maximum diameter of 14 in., ¾ in. to 1½ in. thick, which is easily removed and amply guarded.

The wheel slide may be swiveled and the angle of setting measured by graduations on the base. In addition, the wheel platen may be swung to a maximum angle of 10 deg. This feature enables the operator to grind two different tapers at one setting.

The hand cross feed and quick traverse is operated by a hand wheel located on the front of the machine. This hand wheel has two positions, one engaging the hand cross feed, and the other disengaging the hand cross feed and engaging the quick traverse. The automatic cross feed has a range of feeds from .00025 in. to .004 in. upon each reversal of the table. It is easily operated and can be set automatically to throw the feed out of operation as soon as the work has been reduced to the desired diameter. The wheel is fed to the work while the table is stationary by means of the independent automatic cross feed. At such times the table can

Universal Grinder Equipped With an All-geared Change Speed and Feed Mechanism

be securely held from traversing by a safety lock which prevents the engagement of the longitudinal feed.

The table travels automatically on ways that are well proportioned to give large bearing surfaces. It turns on a central pivot bracket and can be set at an angle with the ways, which are protected by metal covers. Oil is evenly distributed as the table reciprocates by means of rolls turning in oil wells.

The table adjustment is indicated by a scale reading to 8 deg., 3½ in. taper per foot and 30 per cent. Clamps are provided to secure it at both ends and hold it rigid.

The speed of the wheel, the speed of the work and the feed of the table are entirely independent. Four changes of wheel speed are furnished, ranging from 1,500 to 2,400 r.p.m. There are also 12 indicated changes of work speed of 24 to

492 r.p.m. and 12 indicated changes of table feed that can be divided into two series, a slow series of 6 in. to 24 in. per minute, and a fast series of 33 in. to 128 in. per minute. These changes in work speed and table feed are readily available through the medium of two rotating levers conveniently located on the front of the machine. A dial beside each level indicates the speed or feed in operation.

The table can be stopped at any time during its travel by moving the lever located back of the table hand wheel. The reverse mechanism permits the work to be ground close to a shoulder and the table hand wheel is automatically disconnected while the power feed is in operation.

The headstock work drive plate is driven from the main driving shaft at the rear of the machine, through the clutch and speed cases to the transposing gears at the front. These transposing gears, which provide the fast and slow series of speeds, transmit the power to a splined shaft, upon which is mounted a splined sleeve contained within a bevel gear. This bevel gear meshes with another that is mounted upon a shaft contained within the central pivot of the swivel table. Power is transmitted through the bevel gears to a shaft mounted within the swivel table and then through two spur gears at the end of the table, one of which is mounted on the telescoping base shaft of the headstock. The drive from this telescoping shaft is through a series of bevel gears to a short shaft contained within the headstock, from which the final drive to the work driving plate is made by means of a silent chain.

The headstock swivels on a graduated base. It slides on ways and can be clamped at two points. The head spindle is 2 in. in diameter and is hardened, ground and lapped. The front end is threaded for 4½ R.H., U.S.S. thread, and the spindle is also provided with a No. 9 taper hole. It can be locked for grinding on dead centers. The phosphor bronze boxes with means of compensation for wear are protected by metal covers.

The footstock also slides on ways and can be clamped at two points. A holder for a carbon point is attached to it and the wheel can be conveniently trued without removing the work from the centers.

A tank cast in the bed of the machine holds an abundant supply of water. The pump is simple in construction and needs no priming or packing.

The equipment included with the machine consists of a No. 34 internal grinding fixture, an 8-in. four-jawed independent chuck, "face plate," face chuck, two universal back rests, four adjustable bronze shoes, a center rest, two grinding wheels, one offset 12 in. in diameter, and one offset 14 in. in diameter, a set of dogs, a set of telescopic water guards and a full complement of wrenches. Overhead works are also included, consisting of one pair of tight and loose pulleys, 18 in. in diameter, for a 5 in. belt, and a speed of 425 r.p.m.

The machine weighs 6,950 lb. and requires floor space of 42⅝ in. at right angles to the wheel spindle and 142 in. parallel with the spindle. It can hold work 14 in. in diameter by 36 in. in length and swings 12½ in. over the water guards.

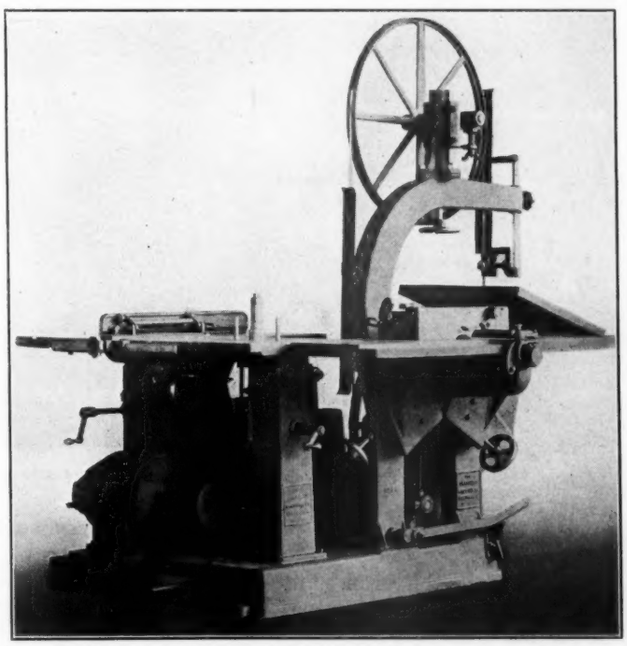
A Wood Worker With Five Separate Tools

THE Crescent Machine Company, Leetonia, Ohio, has re-designed its universal wood working machine. The saw table is now entirely separate from the shaper and the borer is also placed so as to be operated independently. The saw table can be raised and lowered to allow for cutting through various thicknesses of material, and may be tilted to an angle of 45 deg. by means of a hand wheel and worm gear tilting device. A scale and pointer are provided to indicate the degree of angle. These features make the machine as convenient for all practical purposes as independent machines, because it is possible to do five different kinds of work on the machine at one time.

The machine consists of five separate units, a band saw, a jointer, a saw table with tilting top, a shaper and a borer. It is provided with an individual means for starting and stopping each unit independently, so that all five machines can be used at one time. Each of five operators may have complete control of his machine and is free from any interference by any one of the other operators.

Endless leather belts are furnished with the machine for driving each separate unit. The belts are so located within the machine that they are entirely out of the way. The starting and stopping of each part of the machine, with the exception of the shaper, is accomplished by means of a belt-tightening pulley operated by a lever. The tightening pulleys are adjustable, so that the belts may always be used under the proper tension. The belts do not run unless the machines are in operation. The shaper is started, stopped or reversed by means of friction cones controlled by a foot operated lever which may be securely locked in any position. All sliding adjustments are gibbed for the purpose of taking up the wear.

The base is a single cored-out casting, reinforced with heavy ribs. It sets flat on the floor, thus giving substantial support. The several units that compose the machine are mounted on cast iron, cored-out, hollow pedestals that are bolted to the base on machined surfaces. This method of consolidating the pedestals with the base gives to the machine the rigidity and sturdiness of hollow construction, without being cumbersome in appearance, and insures a steady running machine that is practically free from vibration.

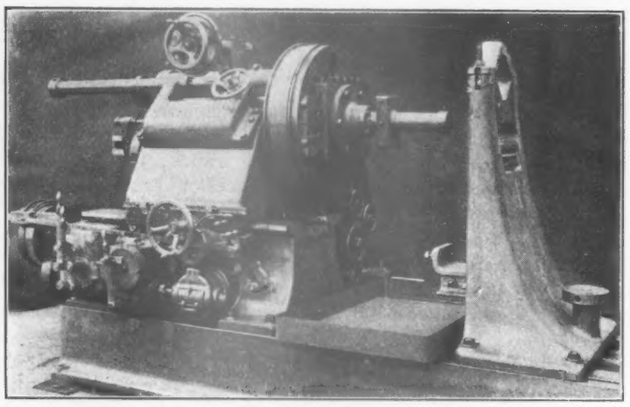


This Machine Is Equipped with a Band Saw, Jointer, Circular Saw, Shaper and Borer

One of the new features of the machine is that no special motor base is required. The regular base is so designed that any standard motor may be easily attached.

Crank Pin Grinding and Quartering Machine

A LOCOMOTIVE crank pin grinding and quartering machine of the double headed type has recently been developed by the Churchill Machine Tool Company, Ltd., Manchester, England. The machine is designed specifically to deal with right hand lead crank pins. It consists of a main base plate which carries two supports for the



The Single End Machine

axle and two grinding heads, located one at each end of the base plate. These heads are operated from the same side of the machine and provision has been made for either an electric motor or overhead countershaft drive, arranged independently for each head. They are carried on slides machined at 90 deg. and are adjustable on the angular slides by means of fixed dead stops, so that the machine can grind crank pins of an effective throw from 11 in. to 15 in. The fixed dead stops are arranged in .1-in. steps to cover the above range.

The driving mechanism of the grinding heads is mounted on a base bolted securely to the base plate. The heads have an automatic traverse of 24 in. on the slides. This length of travel is suitable for the grinding of pins up to 15 in. and also the grinding of parallel crank pin holes through the driving wheel. The main spindles are 6 in. in diameter at the main bearing. The cross adjustment mechanism of the grinding snout for the planetary motion is of rigid construction and provides an accurate and positive feed. A ball thrust is provided at the main spindle to facilitate ease of operation when drilling or boring. The grinding snouts are detachable and various sizes may be used.

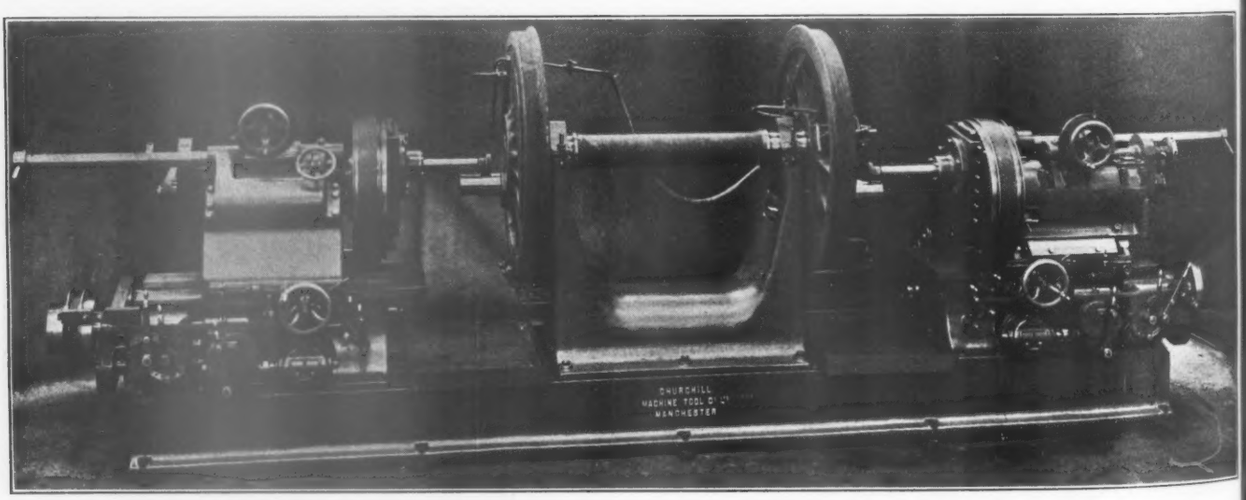
In addition to the traversing motion for the purpose of moving the grinding wheel along the pin, the machine is also provided with a range of boring feeds so that the machine may be fitted with tools for the purpose of drilling and boring holes in a new driving wheel; or in case there is more metal to be removed than would be advisable by the grinding process, it may be fitted with cutting tools for the purpose of turning the pin.

The slide that carries the grinding or boring snouts is arranged so that it can be brought to a position which coincides exactly with the center of the main spindle. A dead stop is provided for this purpose. The tool slide is also provided with a special quick adjustment to the center position. The total amount of this cross adjustment from maximum to zero is 5½ in.

The traverse feeds of the grinding heads, as well as the rotary motion of the main spindle, are obtained from a self-contained gear box, which is provided with three boring feeds, three grinding head traverse speeds, and three spindle speeds. All the control levers are arranged in a convenient location for the operator.

The axle is supported on the journal bearing, as shown in the illustration. The V-blocks are adjustable vertically in the axle supports. The axle can be accurately located for the center height by means of a centering bar carried on each grinding head. Provision is also made for fine adjustment when grinding crank pins and for locking the driving wheel after its proper position has once been determined.

This machine is also built with a single end, the construction of which is in all respects similar to the double-ended machine, with the exception that the left-hand head is not used. A tail stock is fitted to the machine instead, which is provided with centering bars to locate the centers of the axle and crank pin. The approximate net weight of the machine complete is 12½ tons.



This Machine Is Designed Specifically to Handle Right Hand Lead Crank Pins

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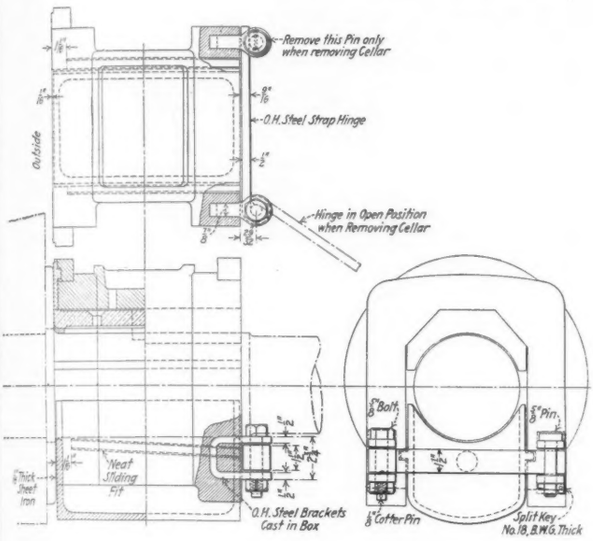
IN ORDER to help the attendant of a punching machine to locate the work under the tool properly, a neat dodge has been adopted by the Pressed Steel Car Company. A small hole is drilled up the center of the punch, and an electric light is arranged in the punchholder above. A spot of light is projected on to the plate, which is manoeuvred until the spot coincides with the centre punch dot of the marker-out.

An Attachment for Holding Journal Box Cellars

AN improved journal box attachment and lubrication cellar is shown in the drawing. This device is adaptable to various types of engines and trailer truck boxes, as well as driving boxes. The drawing shows how it is applied to an engine truck box. The cellar is supported by two slides on the inside of the box, one on each pedestal leg, which extend from the front to 1 1/16 in. to the rear. These slides may be cast in the form of a groove when the box is made, as show in the drawing, or they may be made by welding bent wrought steel plates to the sides so that the projecting leg will carry the cellar. The retaining attachment is made from a piece of 1⅝-in. by ½-in. steel. It operates like a hinge and has one end bent to take the hinge pin. The other end is secured by a pin which fits into a bracket on the opposite side of the box and is prevented from falling out by a split key.


Remove this Pin only when removing Cellar
O.H. Steel Strap Hinge
Hinge in Open Position when Removing Cellar
Outside
⅝" Bolt
⅝" Pin
Heat Sliding Fit
O.H. Steel Brackets Cast in Box
⅝" Cotter Pin
Split Key No.18, B.W.G. Thick

Attachment for Preventing the Loss of Lubrication Cellars

The cellar recommended by the inventors is made from a piece of 1/16-in. sheet brass and has tapered side extensions to engage with the grooves in the box. The drawing shows a cast-iron cellar, but various kinds of cellars may be used to suit the railroad company's standard practice.

This device, known as the E-C journal box attachment and on which patents are pending, was designed by F. H. Einwaechter and F. A. Cardegna, Baltimore, Md. The purpose of the improved fastening is to prevent loss of the cellar. The sheet steel cellar recommended by the inventors is considerably cheaper to make and insures a longer life than the cast steel, cast iron or malleable cellars generally used. The reduction in weight and the easy manner in which the cellars are removed from the box are said to effect a considerable saving of time at terminals in packing and handling.

Cylinder Cock Designed to Operate Automatically

A CYLINDER cock, designed to provide a valve that will drain automatically, has recently been invented (patented) by A. Abbamonte, Cheyenne, Wyo. The device is operated in the following manner: When the main steam throttle is open, the steam pressure closes the valve 7, causing it to rest on the seat *A*. This movement opens the piston 4. When the throttle is closed, the steam pressure is lower than the tension of the spring 2, and this spring closes the piston valve on the seat *B*, thus protecting the operating portion of the cylinder cock from becoming stuck with deposits from the oil. Valve 7 is opened by this return movement and allows all the fluid, that may have accumulated, to escape to the atmosphere through the outlet *C*.

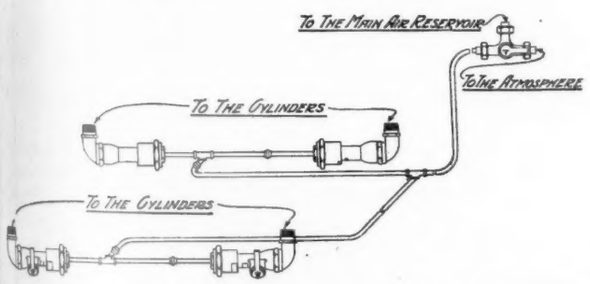
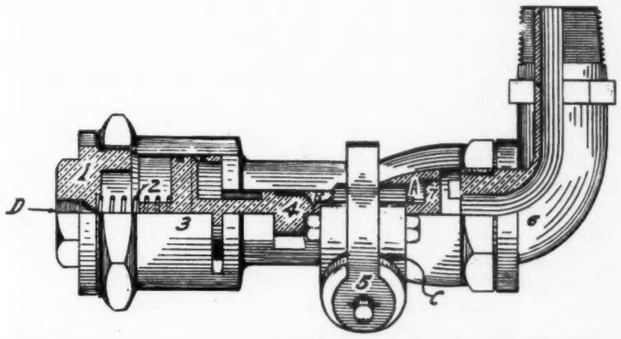


Diagram Showing the Manner in Which the Device Is Applied to the Cylinders

When the engine is drifting with the throttle closed, a vacuum is formed in the steam pipes, steam chests and cylinders, which closes the check valve 5 on the seat of outlet *C*, thus preventing cold air and dirt from entering the cylinders.

When the engineman wants to open the cylinder cocks while the engine is working under full steam pressure, he opens the three-way cock connected to the opening *D* with the main air reservoir. When the three-way cock is opened, the main reservoir is connected on the top of the piston 4, thus closing this piston on the seat *B*, and opening valve 7. This allows the steam to blow from the outlet *C*. When the three-way cock is closed, the opening *D* is exposed to the atmosphere and the steam pressure on the top of valve 7 causes it to reseat itself and to open the piston 4.

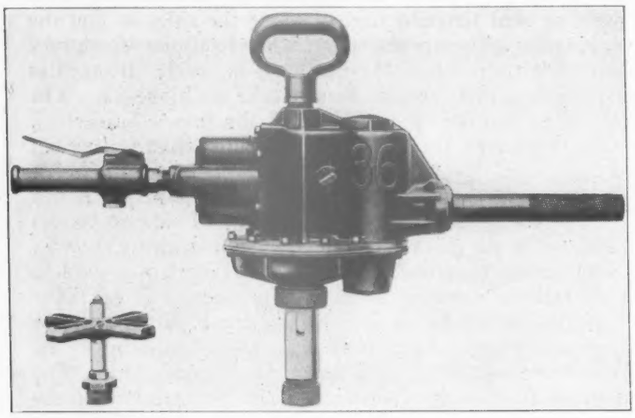
It is essential that the cylinder cock be placed in a horizontal position, with the check valve 5 when at rest in a perpendicular position and ¼ in. from the outlet *C*. This position will make a 55-deg. steam blow from the outlet *C*. About 20 lb. steam pressure is needed to close the valve 7 on its seat and when the pressure is lowered 5 lb. valve 7 will open automatically. When the engineman opens the cylinder cock by air pressure, the piston 4 closes on the seat *E* and stops all air leaks passing through piston ring.



Drawing Showing the Working Parts of the Abby Automatic Cylinder Cock

A Special Air Drill for Reaming Service

THE extent to which portable drills are used in reaming operations in railroad shops, and the special demand of this work arising particularly from the wide fluctuations in load in reaming different thicknesses of materials, has led to the recent development of a portable air drill which is designed specially for this work. This drill is the No. 36 Red Giant drill of the Chicago Pneumatic Tool Company, New York. While the design of this drill is not revolutionary it is distinctive in a number of particulars. The main objectives sought in its development are said to be capacity for uninterrupted service, ease of operation and reduced maintenance.



The Red Giant Portable Drill Used for Reaming

The new drill weighs 35 lb. and is unusually well balanced, affording easy control and enabling it to be handled by one man for down or side hole reaming. The spindle is of the extension type with a slot for the convenient ejection of the reamer or drill. One of the most prominent features of the drill is the power, which is usually large for drills of this weight. This makes the machine especially adaptable where the work varies from single plates to multiple plates and gussets with forgings, gray iron and steel castings interspersed between them, and where the quantity of metal to be removed produces a constantly changing power factor. All of the working parts are made extra large to provide an ample safety factor. As the motor is double acting and is provided with a packing gland or stuffing box, there is no leakage of air into the crank case. The lubrication is of the flash type and as there is no air to bleed through from the crank chamber there is no loss of lubricant as a result of its being carried out into the escaping air. The crank shaft and bearings differ slightly from those of the standard Little Giant designs, having the eccentric located between the throws and an integral part of the forgings. This crank shaft is mounted on three ball bearings, the extra or third ball bearing insuring proper shaft support on both sides of the main drive gear and contributing to an unusually low frictional resistance in the machine.

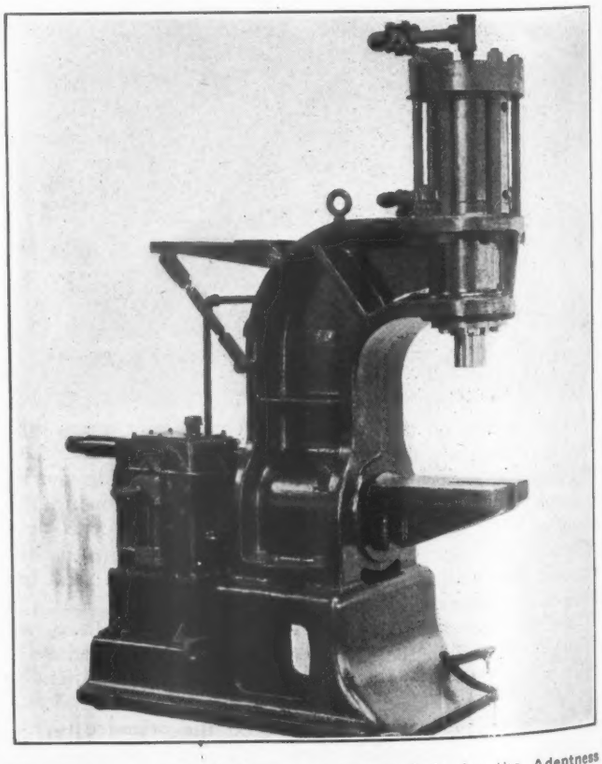
A Self-Contained Hydraulic Riveter

A SELF-CONTAINED riveter of the hydraulic type has recently been developed by the Oilgear Company, Milwaukee, Wis. The machine may be located anywhere on the shop floor where it can be driven from any constant-speed source of power. A constant-pressure pump furnishes oil to the cylinder free from pulsations. The delivery may be changed instantly to any desired pressure from zero to the maximum capacity of the machine and the displacement is positive against any resistance up to the capacity of the machine. Thus there is no delay in waiting for the pressure to build up as it is available the instant resistance is met.

As shown in the illustration, the frame is of ribbed construction and is securely bolted to the bed. The shape of the bed is such that it permits the location of the pump in rear of the frame. This arrangement makes the machine a self-contained unit and also tends to simplify its installation in the shop.

Another feature is that the horns being of the removable type, makes the machine adaptable to the various kinds of work around a railroad shop. All the parts are easily accessible. Special attention was given in the design of the machine to the cost of maintenance, which is an important factor to be considered.

Foot-treadle control is provided which allows the operator the use of both hands for the work. The speed of the machine is limited only by the adeptness of the operator in placing the rivets. The stroke is 4 in. and the design allows for placing the work so that the strokes can be limited to clear the work on the up stroke or on the return to ram position. The horn shown in the illustration is of special design to accommodate an indexing fixture, but removable horns of any design may be used. This riveter is manufactured in two standard sizes of 10 and 20 tons' capacity, respectively. Both of these sizes may be driven from any constant speed source of power, which makes it adaptable to various operating conditions and requirements.

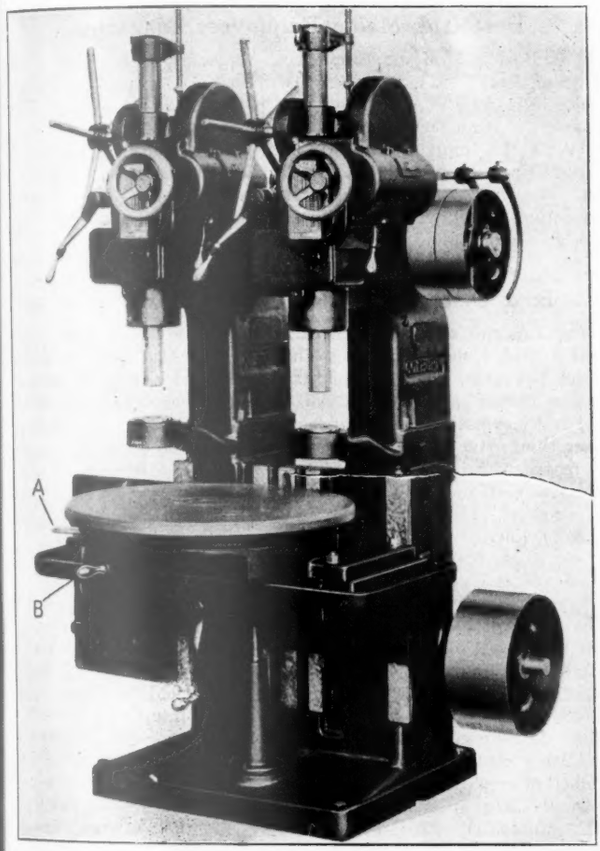


The Speed of This Machine Is Limited Only by the Adeptness of the Operator.

Two-Spindle Drill Press

THE Colburn Machine Tool Works of Cleveland, Ohio, has developed a two-spindle drill press, known as its No. 2 heavy duty. As shown in the illustration, the machine is similar to the regular No. 2 type, except that it is equipped with steady supports and has a special three-station rotating table.

Two No. 2 heads are mounted on a common column, which carries a bracket type table extending the full length of the



Drill Press Equipped with a Special Three-Station Rotating Table

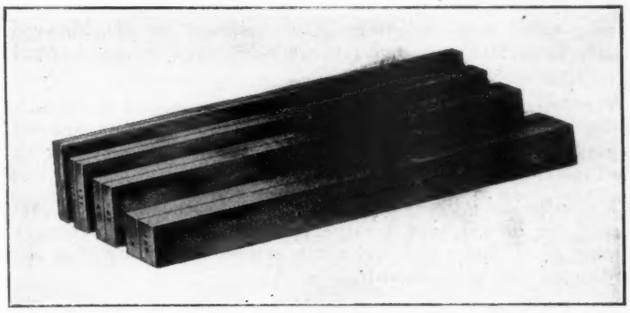
machine. To this table is clamped a rotating table, which is provided with three stations; loading, drilling and reaming. Steady supports are provided for supporting the bar. The indexing latch is released by the lever *A*. The lever *B* is used to clamp the table in position after it has been indexed. An automatic trip, together with spring type counterweights, returns the spindle automatically to the starting position after each operation.

The machine is driven by a five-horsepower motor mounted on a bracket at the rear, and is geared to the jack shaft. Each head is driven by a belt operated from this shaft. The heads are entirely independent of each other and can be operated at different feeds and speeds.

The machine is designed for the purpose of machining duplicate parts in quantities and for handling work requiring a wide range of speeds and feeds. A patented transposing gear arrangement permits flexibility and provides a means for securing the correct speeds and feeds for the work to be performed. On some work where two stations for drilling are wanted, a four-station rotating table can be used instead of the three-station type. The table would then be indexed 180 deg. in order to bring the work under the spindles.

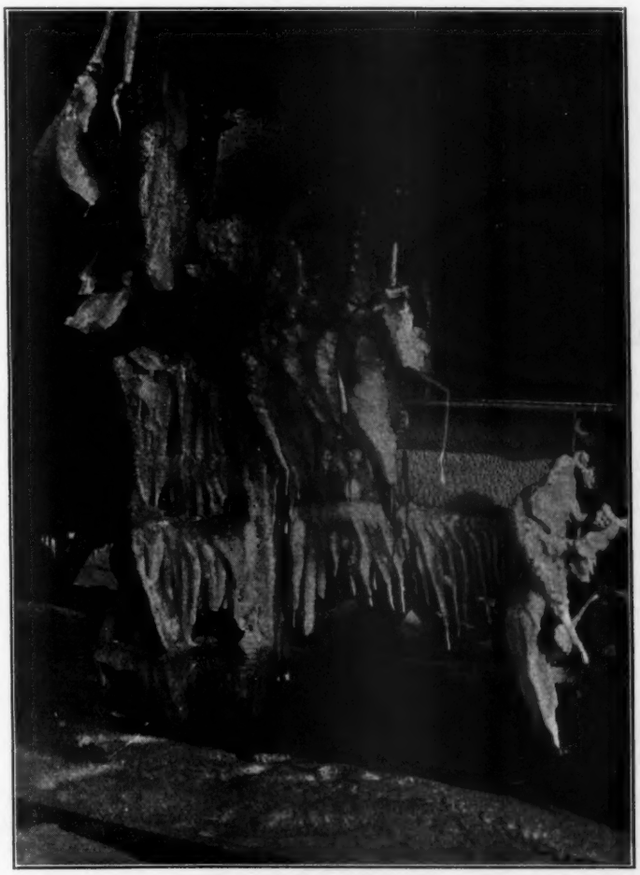
Steel Parallels of Practical Dimensions

THE L. S. Starrett Company, Athol, Mass., has made a recent addition to its line of precision tools in the shape of two sets of parallels made from a special grade of tool



Handy Precision Tools for Mechanic, Toolroom or Machine Shop

steel, hardened and ground. These sets consist of eight pairs of parallels which may be purchased in individual pairs or combinations of pairs by the mechanic, or complete for the tool room or machine shop. The dimensions to which they are made are those which experience has shown to make the most practical combinations. They are all 6 in. in length.



Ice from Stoker Engine Drip Pipe Discharging Near Top of Tender Steps Caused This Condition

GENERAL NEWS

The boiler shop and three other buildings of the Missouri Pacific shops at Ft. Scott, Kans., were destroyed by fire on April 16; estimated loss $30,000.

The Interstate Commerce Commission has reopened its investigation into the question of the construction and repair of cars and locomotives for further proceedings relating to the equipment of the Central of New Jersey.

The Anatolian Railway of Turkey plans to spend over $3,500,000 during the current year for the purchase of 30 locomotives, a number of passenger cars and a new station at Haidir-Pasha, according to Commerce Reports.

The Interstate Commerce Commission's report to Congress for March on the condition of railway equipment shows that during the month 5,083 locomotives were inspected; that 2,674 were found defective and 468 were ordered out of service. Also 99,234 freight cars were inspected, of which 4,461 were found defective; and 1,814 passenger cars, of which 41 were found defective.

In February this year the following railway car supplies were imported into Canada from the United States: 21 box and flat cars, valued at $27,857; 3 tank cars, valued at $1,311; 168 other cars, valued at $6,826; parts of railway cars, valued at $136,169; 3 motor cars for railway use, valued at $607. This is a report compiled by the Dominion Bureau of Statistics.

The Union Pacific has organized a standardization committee which is visiting every shop on the system investigating methods and apparatus with a view to increasing efficiency. The committee consists of J. W. Highleyman, assistant superintendent of motive power and machinery, J. J. Kelker, superintendent of shops at Pocatello, Idaho, W. R. Ladd, superintendent of shops at Portland, Ore., and A. S. Norris, master mechanic at Los Angeles, Cal.

Tank Car Specifications

The effective date of the requirements of Section 7 (c) of the specifications for Class I and II tank cars, and the last paragraph of Section 7 (d) of the specifications for Class III and IV tank cars has been extended to December 1, 1924. These sections of the tank car specifications of the American Railway Association provide that no nipples, valves or other attachments shall project below the bottom outlet cap, except while car is being unloaded.

Labor Board Decisions

REPRESENTATION OF INDIVIDUAL SHOP CRAFTS EMPLOYEES.—The Labor Board decides that the railway employees' department of the American Federation of Labor has the right to represent individual employees on the Great Northern who have grievances under the provisions of the existing agreements. The dispute in this case involved a memorandum of settlement with certain striking shopmen in the latter part of 1922 and its alleged violation in the case of one employee by the railway management.—*Decision No. 2304.*

Boston & Maine Employees' Magazine

The Boston & Maine Employees' Magazine, Vol. 1, No. 1, the issue of April, 1924, has been distributed. It is a 24-page publication, 6 in. by 9 in., illustrated, and it carries no advertising. The company's announcement reads in part:

"With this number the Boston & Maine Bulletin, established a year ago, becomes the Boston & Maine Employees' Magazine. The change is not a new departure but a growth. We have no pretentious plans. But there is need of better means of information about the public service in which we are engaged. . . . ."

B. & O. Fuel Conservation Moving Picture

The Chicago chapter of the International Railway Fuel Association held a special meeting Thursday evening, April 10, at the Hotel Sherman, Chicago, the feature of which was an unusual motion picture presented by W. L. Robinson, superintendent of fuel and locomotive performance of the Baltimore & Ohio. Among other things, the chemistry of combustion is shown in this picture by means of animated characters, carbon being represented by a negro, oxygen by a police officer and hydrogen by a girl called the "Hydro-girl." This was the first showing of the film off the B. & O. lines.

Wage Statistics for January

In January, 1924, the number of employees of Class I railroads was the lowest recorded since September, 1922, according to the Interstate Commerce Commission's monthly bulletin of wage statistics. The number reported was 1,749,927, a decrease of 29,589, or 1.7 per cent as compared with the returns for the same month last year. The total compensation decreased $10,501,535, or 4.2 per cent. The difference in the percentage decrease in the number of employees and their compensation was due chiefly to an unusually large number of overtime hours worked in January, 1923. Compared with the preceding month, the reports for January, 1924, show a decrease in employment of 2.4 per cent. The total compensation, however, shows an increase of 2.1 per cent due principally to the fact that the number of working days was greater.

Standardization of Freight Cars in England

A plan for standardization of railway freight cars has been arranged between the railway clearing house for the companies and the private car owners, by which all freight cars built in future will be of two standard specifications only—12-ton and 20-ton. This change, contemplated for years, may be attributed largely to the unification of railways under the act of 1921. Great savings are anticipated eventually from this plan, not only in

LOCOMOTIVE REPAIR SITUATION—FORMER METHOD OF COMPILATION

Date	No. locomotives on line	No. serviceable	No. stored serviceable	No. held for repairs req. over 24 hours	Per cent	No. held for repairs req. less 24 hours	Per cent	Total held for repairs	Per cent
January 1	64,453	48,905	576	13,587	21.1	1,962	3.0	15,549	24.1
April 1	64,559	50,107	914	12,801	19.8	1,651	2.6	14,452	22.4
July 1	63,906	52,456	2,181	10,326	16.2	1,124	1.8	11,450	18.0
October 1	63,982	54,159	2,620	8,789	13.7	1,034	1.6	9,823	15.3
1924									
January 1	64,406	54,031	5,061	9,395	14.6	980	1.5	10,375	16.1

LOCOMOTIVE REPAIR SITUATION—NEW METHOD OF COMPILATION

Date	No. locomotives on line	No. serviceable	No. stored serviceable	No. req. classified repairs	Per cent	No. req. running repairs	Per cent	Total req. repairs	Per cent
February 1	64,377	53,586	4,116	5,919	9.2	4,872	7.6	10,791	16.8
March 1	64,431	53,127	3,800	6,047	9.4	5,257	8.1	11,304	17.5
April 1	64,363	52,805	4,648	6,128	9.5	5,430	8.4	11,558	17.9

facilitating repair and in aiding train assembly, but also in cheapening first cost and in promoting mass production.

Quantity output schemes are already being introduced at car-building plants. At Cardiff, an extension of the Crown Wagon & Engineering Works is under way to expedite the specialized construction of steel-frame box cars and the construction of the new 20-ton coal cars. The Great Western Railway serving that territory is urging colliery owners to adopt the 20-ton size, and offers a 5 per cent freight rebate on coal traffic so carried.

Canadian Shopmen Favor B. & O. Plan of Co-operation

The convention of the Canadian section of Division 4, Railway Employees Department, of the American Federation of Labor, meeting in Montreal, representing 35,000 rail shopmen on Canadian lines, has gone on record as favoring the Baltimore & Ohio plan of co-operating with the management and expressed the desire to see the plan adopted in Canada. Following the endorsement by the convention, the matter will be taken up by the Canadian Pacific System Federation and the Canadian National System Federation at their conventions which open simultaneously in Montreal immediately upon the conclusion of the Division 4 convention. The next step would be the making of a survey of the line to designate some one point at which the plan could be tried out. Managements of the railways would then be approached. A vote of the men throughout the system would be necessary before the plan could be put into effect.

Locomotive Shipments in March

The Department of Commerce has prepared the following table of shipments of locomotives in March. This report covers the principal manufacturing plants and is based on reports received from the individual establishments. The table gives the shipments of locomotives in March and unfilled orders as of March 31, with comparisons for earlier months.

Year and month	Locomotives Shipments			Unfilled orders		
1923	Total	Domestic	Foreign	Total	Domestic	Foreign
January	229	217	12	1,788	1,699	89
February	207	196	11	2,220	2,141	79
March	282	269	13	2,316	2,214	102
April	217	201	16	2,204	2,111	93
May	238	228	10	2,150	2,045	105
June	232	221	11	1,958	1,854	104
July	239	211	28	1,738	1,652	86
August	272	259	13	1,497	1,406	91
September	335	313	22	1,178	1,102	76
October	310	295	15	977	915	62
November	299	270	29	691	656	35
December	329	305	24	387	365	22
1924						
January	151	147	4	376	344	32
February	99	92	7	499	466	33
March	132	128	4	534	494	40

Labor News

The Nashville, Chattanooga & St. Louis has granted increases of one cent an hour to employees in the mechanical department; mechanics, carmen, helpers, apprentices and laborers.

To enable their union to become "more militant" railway shopmen of the Canadian Pacific Railway last week devised ways and means of increasing the revenue of their organization by 100 per cent. The decision was made by forty delegates who attended a convention of the company's Federation of Employees. Their action is regarded in Montreal as significant, in view of the approval last week of a draft wage scale which would raise the wages of shopmen to the 1920 level.

Announcement was made in Boston on April 4 that the strike of shopmen on the Boston & Maine, which was begun on July 1 1922, had been called off.

The Federated Shop Crafts on the Baltimore & Ohio have made a request for a general increase of pay sufficient to restore the rates which were in force on July 1, 1921.

The strike of the shop crafts employees on the Chicago, Rock Island & Pacific, which began on July 1, 1922, has been officially terminated by the Railway Employees' Department of the American Federation of Labor, in accordance with a plan upon which the Rock Island offered to reemploy the strikers. Former employees who desire to return to work are to register at points where they formerly worked within the next 60 days. Those who register will be given preference for employment over other new men during the 60-day period of registration and for six months thereafter. Employees who register will be provided with work as soon as opportunity offers, but present employees will not be displaced. The rights and seniority of the men now in service will not be interfered with or affected by the employment of any former shop employees. In the reemployment of former employees who register the relative seniority rights as among themselves will prevail, in accordance with the seniority roster before the strike began. This does not mean that former employees will secure their old seniority, but that their seniority as new men will be arranged according to their seniority before the strike. The Rock Island has refused to enter into any contract with the federated shop crafts and will continue to negotiate with its shopmen through the present "company" organization.

MEETINGS AND CONVENTIONS

The Association of Railway Electrical Engineers will hold its semi-annual meeting on Thursday, June 12, at the Hotel Dennis, Atlantic City, N. J.

Fuel Association Convention

The International Railway Fuel Association will hold its convention at the Hotel Sherman, Chicago, on May 26-29. R. H. Aishton, president of the American Railway Association, and Charles Donnelly, president of the Northern Pacific, will address the meeting. The subjects to be discussed will include oil and coal as locomotive fuel; the budget system; fuel losses at locomotive terminals; the mining, preparation and inspection of coal for locomotive fuel; main tracking and its effect on fuel, and the analysis of the report of the United States Coal Commission.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

AIR-BRAKE ASSOCIATION.—F. M. Nellis, Room 3014, 165 Broadway, New York City. Next meeting Mt. Royal Hotel, Montreal, May 6 to 9.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

AMERICAN RAILROAD ASSOCIATION, DIVISION V.—MECHANICAL.—V. R. Hawthorne, 431 South Dearborn St., Chicago. Convention June 11-18, 1924, Atlantic City, N. J.

DIVISION V.—EQUIPMENT PAINTING DIVISION.—V. R. Hawthorne, Chicago.

DIVISION VI.—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey St., New York. Convention June 16-18, 1924, Atlantic City, N. J.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—J. A. Duca, tool foreman, C. R. I. & P., Shawnee, Okla. Annual convention August 28-30, Hotel Sherman, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, A. F. Stuebing, 23 West Forty-third St., New York. Spring meeting.

FREIGHT CARS, INSTALLED AND RETIRED

Month	Installed during month	Aggregate capacity tons	Retired during month	Aggregate capacity tons	Owned at end of month	Aggregate capacity tons	Building in R. R. shops
December, 1923	18,690	881,168	14,411	548,950	2,307,997	100,527,725	1,515
Full year, 1923	183,367	.....	185,508	.....	.....	.....	.....
January, 1924	15,589	707,367	12,329	516,695	2,310,032	100,644,107	2,417
February, 1924	11,386	554,481	10,466	411,228	2,310,570	100,767,731	2,715
March, 1924	9,923	.....	.....	.....	.....	.....	.....
Total for 2 months	26,975	.....	22,795	.....	.....	.....	.....

Figures as to installations and retirements prepared by Car Service Division A.R.A. published in Form CS 15-A. Figures cover only those roads reporting to the Car Service Division. They include equipment received from builders and railroad shops. Figures of installations and retirements alike include also equipment rebuilt to an extent sufficiently so that under the accounting rules it must be retired and entered in the equipment statement as new equipment. Total of cars retired will include in addition to such rebuilt cars, equipment sold to other than railroad companies such as Sandy Valley & Elkhorn equipment turned over to Consolidation Coal Company as a result of sale of S. V. & E. by Baltimore & Ohio to the coal company. Figures reported by the Car Service Division include cars owned by railroad controlled private car lines,—American Refrigerator Transit, Fruit Growers Express, Pacific Fruit Express, Merchants Dispatch Transportation Company and Western Fruit Express. The railroads turned over a large number of cars to these respective companies during 1923. Such equipment is shown as retired by the railroads and installed by the car lines. Figures for the car lines mentioned show that during 1923 they installed 14,508 cars including new and cars of former railroad companies. The car lines retired 293 cars and on January 1, 1924, had 1,240 cars on order.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio. Next meeting September 22-26, inclusive, at Boston, Mass.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa. Annual meeting June 23-27, Chalfonte-Haddon Hall, Atlantic City, N. J.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill. Semi-annual meeting June 12, Hotel Dennis, Atlantic City, N. J.

CANADIAN RAILWAY CLUB.—W. A. Booth, 53 Rushbrook St., Montreal, Que., Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—R. E. Giger, 721 North 23rd street, E. St. Louis, Ill. Meetings, first Tuesday in month at the American Hotel Annex, St. Louis.

CENTRAL RAILWAY CLUB.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Regular meetings second Thursday, January to November. Interim meetings second Thursday, February, April, June, Hotel Statler, Buffalo, N. Y.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—A. S. Sternberg, Belt Railway, Clearing Station, Chicago. Annual meeting Hotel Sherman, Chicago, September 16, 17 and 18.

CINCINNATI RAILWAY CLUB.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings second Tuesday, February, May, September and November. Next meeting May 13. The speaker will be E. S. Jouett, vice-president, Louisville & Nashville.

CLEVELAND STEAM RAILWAY CLUB.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meeting first Monday each month at Hotel Cleveland, Public Square, Cleveland.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Next meeting Hotel Sherman, Chicago, August 19, 20, 21.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. B. Hutchinson, 6000 Michigan Ave., Chicago, Ill. Next meeting Hotel Sherman, Chicago, May 26, 27, 28.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabash St., Winona, Minn. Annual convention September 9 to 12. Hotel Sherman, Chicago.

MASTER BOILERMAKERS' ASSOCIATION.—Harry D. Vought, 26 Cortlandt St., New York, N. Y. Next convention May 20-23. Hotel Sherman, Chicago.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meetings second Tuesday in month, except June, July, August and September, Copley-Plaza Hotel, Boston, Mass. Next meeting May 13. Annual banquet and entertainment.

NEW YORK RAILROAD CLUB.—H. D. Vought, 26 Cortlandt St., New York. Meeting third Friday of each month except June, July and August at 29 West Thirty-ninth St., New York.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—George A. J. Hochgreb, 623 Brisbane Building, Buffalo, N. Y.

PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings second Thursday in month, alternately in San Francisco and Oakland, Cal.

RAILWAY CLUB OF GREENVILLE.—G. Charles Hoey, 27 Plum St., Greenville, Pa. Meetings last Friday of each month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Tuesday in month, except June, July and August, Fort Pitt Hotel, Pittsburgh, Pa.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings second Friday in month, except June, July and August. Next meeting May 9. A paper on the Consolidation of Railroads, or some kindred matter will be read by W. A. Colston, vice-president and general counsel, N. Y., C. & St. L., Cleveland, Ohio.

SOUTHEASTERN CARMEN'S INTERCHANGE ASSOCIATION.—J. E. Rubley, Southern railway shops, Atlanta, Ga.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio. Annual meeting Hotel Sherman, Chicago. September 9-14, 1924.

WESTERN RAILWAY CLUB.—Bruce V. Crandall, 605 North Michigan Ave., Chicago. Meetings third Monday in each month, except June, July and August. Annual meeting May 23, at Edgewater Beach Hotel, Chicago. Fred W. Sargent, vice president of the Chicago & North Western, will be the speaker.

Burlington Route

GOOD CYLINDER VALVE PACKING ARE TRUE FRIENDS OF THE ENGINEER AND FIREMAN

Burlington Route

Example of 28-in. by 22-in. Placards to be Posted Monthly in Enginehouses and Enginemen's Washrooms by the Chicago, Burlington & Quincy for the Purpose of Causing Discussion and Creating Interest in Fuel Economy.

SUPPLY TRADE NOTES

The T. H. Symington Company has moved its Chicago offices to 2108 Straus building.

The American Steel Foundries has moved its Chicago offices to 410 North Michigan avenue.

John H. Lord, of Joseph T. Ryerson & Son, Inc., Chicago, died on March 30 at Louisville, Ky.

The Griffin Wheel Company has removed its Chicago office from 332 South Michigan avenue to 410 North Michigan avenue.

Charles N. Winter, managing editor of the Locomotive Cyclopedia and the Car Builders' Cyclopedia, has resigned to become general manager of the Rogatchoff Company of Baltimore, Maryland. Mr. Winter began his engineering career in 1904 in Poughkeepsie, N. Y. In 1906 he entered the engineering department of the American Brake Shoe & Foundry Company, serving as draftsman and as engineering inspector of new work. He resigned this position to enter the engineering department of the American Car & Foundry Company at New York, in 1913 returning to the American Brake Shoe & Foundry Company as chief draftsman. In 1915 he removed to Virginia where he served in the test department of the Norfolk & Western at Roanoke, and in the office of the engineer at the Richmond Works of the American Locomotive Company. In 1918, Mr. Winter accepted a position on the editorial staff of the Simmons-Boardman Publishing Company and compiled the 1919 edition of the Car Builders' Cyclopedia. At the close of this work he became associate editor of the Railway Age and the *Railway Mechanical Engineer*. In 1921 he became managing editor of both the Locomotive Cyclopedia and the Car Builders' Cyclopedia, resigning from this latter position to take up his new duties which will include the direction of sales and advertising for the Rogatchoff Company in the United States and Canada, and also in Great Britain and Australia. The sales offices will be located at 90 West Broadway, New York City, and in the Koehler Building, Ridgewood, N. J.

C. N. Winter

The American Car & Foundry Company has acquired the plants of the Pacific Car & Foundry Company at Portland, Ore., and Seattle, Wash.

The Union Tank Car Company, New York, will, on May 15, establish an office in the McCormick Building, 332 South Michigan avenue, Chicago.

H. S. Patterson, manager of the railroad department of the Walworth Manufacturing Company, Boston, Mass., died on April 6 at Norfolk, Mass.

M. A. Downs and W. G. Guy have been appointed service engineers in the railroad department of the Paige & Jones Chemical Co., New York City.

The Sellers Manufacturing Company, Chicago, has moved its general sales offices from 1204 McCormick building to 1927 Illinois Merchants Bank building.

The Zapon Leather Cloth Company has moved its New York offices from 200 Fifth avenue to the Park-Lexington building, Park avenue and Forty-sixth street.

The Westinghouse Air Brake Company has removed its New York office from the Benenson building, 165 Broadway, to the new

Westinghouse building, which has just been completed at 150 Broadway.

The Lone Star Tank Car Company, Wichita Falls, Tex., is contemplating the construction of a plant for the repairing of tank, steel and gondola cars at Fort Worth, Tex.

James A. Long has been appointed general manager of the Woodward Iron Company, Woodward, Ala., succeeding A. J. Boynton, who is now associated with H. A. Brassert, Inc., Chicago.

Edwin W. Allen, assistant district manager and district engineer of the General Electric Company, with headquarters at Chicago, has been promoted to manager of engineering, with headquarters at Schenectady, N. Y.

The Youngstown Steel Car Company, Niles, Ohio, has opened a new district office in the Canadian Pacific building, New York City. This office is in charge of John H. McCartney, formerly representative at New York for the Standard Tank Car Company.

C. A. Paquette, chief engineer of the Cleveland, Cincinnati, Chicago & St. Louis, with headquarters at Cincinnati, Ohio, has been appointed president of the M. E. White Company, the White Construction Company and other affiliated companies, with headquarters at Chicago.

The North Judson Car & Equipment Company, North Judson, Ind., has been organized for the purpose of rebuilding and repairing railroad freight cars. It also intends to go into the building of new equipment in the near future. The company has a tract of 70 acres at North Judson, Ind., on which it is now erecting buildings. A. M. Oliver is president and general manager, C. E. Reese is vice-president, A. Lincoln Long is secretary and treasurer and J. G. Capouch is general counsellor.

Death of Dr. Wilhelm Schmidt, Famed for Work with Locomotive Superheater

Dr. Wilhelm Schmidt, whose pioneer work relating to the art of steam superheating led to the development of the most widely used types of locomotive superheaters, died on February 16 at Bethel, near Bielefeldt, Germany, at the age of 66. Dr. Schmidt started his career as a locksmith and through coincidences his natural ability to speculate correctly on matters of physics and engineering came to the attention of prominent men who made it possible for him to educate himself and carry through the realization of his ideas. Schmidt, who in early years recognized the great importance of the superheating of steam for the economy of steam engines, spent the larger part of his life in fighting the prejudices that made learned engineers opposed to this practice and to build up an organization which was finally able to overcome these prejudices and carry his ideas to commercial success. His best known accomplishment was the creation of a practical locomotive superheater, but he also did much towards the practical superheating of steamships and stationary power plants. In the last ten years of his life he spent much effort and vast sums of money on the demonstration of practical ways and means to combine the thermal advantages of high superheat with the thermal advantages of relatively high steam pressures, which he termed "super-pressures." While he did not live to see his inventions relating to steam super-pressures widely exploited, he had the satisfaction of having the engineering fraternity of his own country acknowledge the genius of his conceptions in this field, also. As a man entirely self-educated, he had many unusual honors conferred upon him, and one of the universities of his country conferred upon him an honorary degree of Doctor of Engineering.

Dr. W. Schmidt

TRADE PUBLICATIONS

GRAPHIC INSTRUMENTS.—Bulletin No. 324, a four-page folder touching upon the use of graphic instruments in small plants, the use of graphic records to effect various plant economies, has been issued by the Esterline-Angus Company, Indianapolis, Ind.

OILGEAR PRODUCTS.—Four bulletins, Nos. 30, 31, 32 and 33, descriptive of broaching and assembling presses, the Type W variable delivery pump, the Oilgear hydraulic riveter and the Oilgear bench press, have been issued by the Oilgear Company, Milwaukee, Wis.

FUEL LINE TUBING.—A 20-page brochure, containing a complete report of tests made by the Underwriters' Laboratories in Chicago and describing the entire process in the manufacture of Bundy tubing, has been issued by the Bundy Tubing Company, Detroit, Mich.

LATHES.—A brief outline of the construction details of LeBlond machine tools and a few of their applications to railroad work are contained in a 46-page illustrated book recently issued by the R. K. LeBlond Machine Tool Company, Cincinnati, Ohio. The book is entitled "LeBlond Lathes in Railway Maintenance Service."

BENT-TUBE BOILERS.—The Heine Boiler Company, St. Louis, Mo., has issued an attractive 26-page bulletin, No. 54, descriptive of its V-type, bent-tube boiler, which consists of three upper steam and water drums and one lower water drum, interconnected by bent tubes acting as steam conductors or water circulators. Details of the construction of various installations are shown in cross-sectional views.

MATERIAL HANDLING EQUIPMENT.—Catalogue No. 21-M, recently issued by the Yale & Towne Manufacturing Company, Stamford, Conn., contains complete details of Yale chain blocks, trolleys and electric chain hoists, and shows tables of dimensions, weights, clearances, and lifting, lowering and running speeds. All essential information regarding each of these units for handling materials is also covered in the catalogue, which contains 100 neatly arranged pages.

ELECTRIC FURNACES.—Annealing of castings and wire, heat treating, calorizing, sherardizing and other processes using electric furnaces, are shown in Bulletin No. 48721 recently issued by the General Electric Company, Schenectady, N. Y. The publication is mostly pictorial in content, illustrating the application of direct heat electric furnaces in General Electric factories. Details as to heat, dimensions and function of each installation featured are given in descriptive captions.

PRESSURE BLOWER SIZES.—Bulletin No. 402, issued by the Johnston Manufacturing Company, Minneapolis, Minn., contains some interesting data and curves showing the general design and operating characteristics of the pressure blowers which this company makes for oil-burning furnaces and large coal forges. Of particular interest on page 3 of the bulletin is the description of a method of determining blower sizes for different installations. A table on page 4 is devoted to the dimensions and motor ratings for blowers of different capacities.

THE AUTOMATIC FIRE DOOR.—The present position in the field of locomotive operation of the automatic fire door, particularly as relates to the Shoemaker radial fire door, is clearly outlined in a four-page circular recently issued by the National Railway Devices Company, Chicago. The construction of the Shoemaker radial type door is clearly shown and red arrows pointing to various parts of the door emphasize its operating advantages. The fourth page of the circular is devoted to a diagram which shows the clearance lay-out of the Shoemaker radial fire door with a commonly applied mechanical stoker.

ALL METAL CAR CONNECTIONS.—A four-page catalogue No. 83 has been issued by the Barco Manufacturing Company, Chicago, devoted to steam heat connections between passenger cars, pointing out the benefits to be derived from making these connections metallic. Tests are quoted to show that the metallic joints tend to promote safety and in a specific case enable the regulating valve pressure to be increased 50 per cent or from 61 lb. to 93 lb. With this initial pressure 5 lb. of steam was obtained at the rear of a 10 car train in 6 min. 21 sec. Metallic steam heat and air connections in stations and yards are also shown in several illustrations.

PERSONAL MENTION

General

L. D. Freeman, assistant to the chief of motive power and equipment of the Seaboard Air Line with headquarters at Norfolk, Va., has resigned to become assistant to the chief mechanical officer of the Chesapeake & Ohio, with headquarters at Richmond, Va.

Master Mechanics and Road Foreman

T. J. Clayton has been appointed master mechanic of the Texarkana & Ft. Smith, with headquarters at Port Arthur, Tex., succeeding A. D. Williams, assigned to other duties. The headquarters of the master mechanic are changed from Texarkana, Tex., to Port Arthur.

J. Dietrich, master mechanic of the Lincoln division of the Chicago, Burlington & Quincy, with headquarters at Lincoln, Nebr., has been given extended jurisdiction to include the Omaha division, succeeding F. Newell, who has been assigned to other duties. The position of master mechanic at Omaha has been abolished.

George H. Langton, whose appointment as general master mechanic of the Chesapeake & Ohio was announced in the April issue of the *Railway Mechanical Engineer*, was born on April 13, 1872, at Hannibal, Mo. Mr. Langton received a grammar school education and served his apprenticeship on the Chicago, Burlington & Quincy. He was subsequently employed on various roads as a machinist, roundhouse foreman, general foreman and engineer, and successively served as master mechanic of the Sierra Railway of California; the Kansas City Southern and Texas Pacific roads. He then became superintendent of shops and master mechanic on the Seaboard Air Line, later holding similar positions on the Virginian. In March, 1923, he was appointed mechanical inspector of the Chesapeake & Ohio and in February of this year was promoted to general master mechanic, with headquarters at Clifton Forge, Va.

George H. Langton

Car Department

Charles T. Reynolds, general inspector of car maintenance of the Boston & Maine at North Station, Boston, Mass., has been transferred to Concord, N. H.

Frank H. Becherer has been appointed general inspector of car maintenance of the Boston & Maine, with headquarters at North Station, Boston, Mass., succeeding C. T. Reynolds, transferred.

Shop and Enginehouse

A. C. Melanson has been appointed acting superintendent of the St. Malo shops of the Canadian National.

John Hayes, roundhouse foreman of the St. Louis-San Francisco at Sapulpa, Okla., has been transferred to Afton, Okla.

J. V. Stevens has been promoted to assistant roundhouse foreman of the Atchison, Topeka & Santa Fe at Clovis, N. M.

George C. Street, drop pit foreman of the St. Louis-San Francisco at Sapulpa, Okla., has been appointed roundhouse foreman, succeeding John Hayes.

Wallace W. Brown has been appointed assistant superintendent of shops of the Boston & Maine, with headquarters at Billerica, Mass., succeeding G. A. Silva.

T. W. Seery has been promoted to assistant night roundhouse foreman of the Atchison, Topeka & Santa Fe, at Clovis, N. M., succeeding F. J. Repman, transferred.

R. H. Mallett, assistant roundhouse foreman of the Atchison, Topeka & Santa Fe at Clovis, N. M., has been promoted to roundhouse foreman, with headquarters at Belen, N. M.

Harry L. Leighton has been appointed superintendent of shops of the Boston & Maine with headquarters at Billerica, Mass., succeeding Thomas Jennings, assigned to other duties.

George A. Silva has been appointed general inspector of locomotive maintenance of the Boston & Maine, with headquarters at North Station, Boston, Mass., succeeding H. L. Leighton.

Major J. W. Lemon, whose promotion to superintendent of shops of the Missouri Pacific at Sedalia, Mo., was announced in the April issue of the *Railway Mechanical Engineer*, was born at Newton, Kans., on February 24, 1879. Mr. Lemon was educated at Pueblo, Colo., and on April 23, 1896, entered the employ of the Denver & Rio Grande as a machinist apprentice. In 1900 he entered train service on the Missouri Pacific as a brakeman between Pueblo, Colo., and Horace, Kan. In 1902 he became a machinist at Hoisington, Kans., and in 1910 was promoted to general foreman. He enlisted with the 31st Engineers, U. S. Army, in June, 1918, and served with the American Expeditionary Forces in England and France until October, 1919, when he returned to the United States and was discharged at Washington, D. C. In November, 1919, he was appointed master mechanic of the Central Kansas-Colorado Division of the Missouri Pacific, which position he held until his promotion to shop superintendent at Sedalia.

Purchasing and Stores

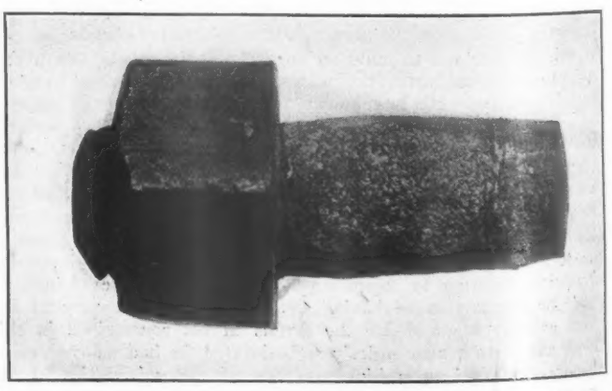
J. H. McGlothlin has been appointed general storekeeper of the Virginian, with headquarters at Princeton, succeeding D. C. King.

L. C. Thomson, chief of stores of the Canadian National, at Montreal, Que., has been promoted to manager of stores, with the same headquarters.

D. C. King, general storekeeper of the Virginian, at Princeton, W. Va., has been promoted to purchasing agent, with headquarters at Norfolk, Va., succeeding Tom Moore, resigned.

G. W. Caye, purchasing agent of the Canadian National, at Montreal, Que., has been appointed purchasing agent of the Grand Trunk Western lines, with headquarters at Detroit, Mich.

L. Lavcie, purchasing agent of the Central region of the Canadian National at Toronto, Ont., has been promoted to general purchasing agent, with headquarters at Montreal, Que.



Stud Blown from Boiler Back Head